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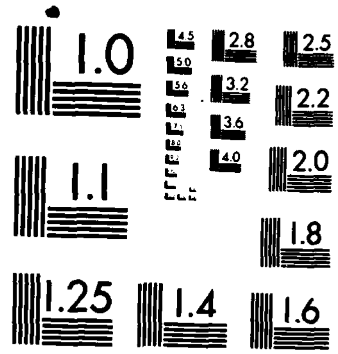

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AIR FORCE HUMAN RESOURCES LABORATORY

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ASSET USERS GUIDE: APPLICATION

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This users guide provides information about the procedures and analytical tools contained in the Acquisition of Supportable Systems Evaluation Technology (ASSET) methodology. It consists of six computer models and eight procedures. The models are (a) Reliability and Maintainability (RM), (b) Realiability and Maintainability Cost Model (RMCM), (c) Training/Aiding Matrix (TAM), (d) Page-Estimating Equations (PAGES), (e) Training Requirements Analysis Model (TRAMOD), and (f) Personnel Availability Model (PAM). The procedures are (a) Program Definition Analysis, (b) Consolidated Data Base Development, (c) Maintenance Action Network, (d) Integrated Task Analysis, (d) Logistics Resources Assessment, (f) Comparability Analysis, (g) Life Cycle Cost Assessment, and (h) Design Option Decision Tree. This users guide provides the input requirements, detailed output, access instructions, and algorithms of four of the computer models (RM, RMCM, TAM, and PAGES). TRAMOD, and PAM documentation is referenced in the users guide but not involved. General information regarding the procedures is also provided.

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DESCRIPTION OF THE SOFTWARE

A. Program Name: Acquisition of Supportable Systems Evaluation Technology (ASSET).

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INSTRUCTIONS FOR REQUESTING COPIES

For more information regarding this program contact the Acquisition Logistics Branch of the Logistics and Human Factors Division, Air Force Human Resources Laboratory (AFHRL/LRA). Commercial Phone: (513) 255-3871; AUTOVON: 785-3871.

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SUMMARY

This users guide provides information about the procedures and analytical tools contained in the Acquisition of Supportable Systems Evaluation Technology (ASSET) methodology. It consists of six computer models and eight procedures. The models are (a) Reliability and Maintainability (RM), (b) Realiability and Maintainability Cost Model (RMCM), (c) Training/Aiding Matrix (TAM), (d) Page-Estimating Equations (PAGES), (e) Training Requirements Analysis Model (TRAMOD), and (f) Personnel Availability Model (PAM). The procedures are (a) Program Definition Analysis, (b) Consolidated Data Base Development, (c) Maintenance Action Network, (d) Integrated Task Analysis, (e) Logistics Resources Assessment, (f) Comparability Analysis, (g) Life Cycle Cost Assessment, and (h) Design Option Decision Tree. This users guide provides the input requirements, detailed output, access instructions, and algorithms of four of the computer models (RM, RMCM, TAM, and PAGES). TRAMOD, and PAM documentation is referenced in the users guide but not involved. General information regarding the procedures is also provided.

PREFACE

A number of different technologies have been developed under the auspices of the Air Force Human Resources Laboratory. These technologies are applied to a hardware system to examine various critical support elements and provide quantitative decision making information towards evaluation of design alternatives and reducing the life cycle cost of the system. These technologies are integrated into the Acquisition of Supportable Systems Evaluation Technology (ASSET).

This document is the User's Guide for the ASSET package. The procedures, models and consolidated data base comprising the ASSET methodology are described to provide an understanding of their capabilities and use in applications.

ACKNOWLEDGEMENTS

The professional efforts of several Air Force Human Resource Laboratory personnel enhanced the User's Guide by answering many technical questions, assisting in the coordination of the CYBER computer system use and providing technical and computer information which was generated during previous contract efforts. Comments made by Miss R. J. Preidis, Mr. H. A. Baran and Dr. W. B. Askren during the project reviews and the computer modeling knowledge of Mrs. S. R. Nichols assisted in familiarizing Westinghouse with the research and development efforts connected with the production of this User's Guide.

Several Westinghouse personnel were involved in the generation and production of this guide. In particular, Mrs. D. S. Egber, Mr. C. Rosander, Mr. W. R. Wakefield, Mr. H. H. White and Mr. K. E. Whitfield each assisted in various activities. The Westinghouse program manager, Mr. R. C. Banta, was also instrumental in the generation and production effort. Secretarial support and assistance for draft documents was provided by Mrs. C. Clevenstine. Final production efforts were provided by the Westinghouse Technical Publications Section and were coordinated by Mr. W. L. Miller. Text processing was provided by Ms. B. L. Frederick and Ms. D. A. Button. Computer graphics were done by Mr. D. M. Lake and cover design by Mr. A. J. Podgurski and Mr L. Moore III.

LIST OF ACRONYMS AND ABBREVIATIONS

TERM	DEFINITION
A	Availability
AFHRL	Air Force Human Resources Laboratory
AFR	Air Force Regulation
AFSC	Air Force Specialty Code
ASSET	Acquisition of Supportable Systems Evaluation Technology
ATIM	Annotated Task Identification Matrix
BIT	Built-In Test
BITE	Built-In Test Equipment
CA	Comparability Analysis
CDB	Consolidated Data Base
CDRL	Contract Data Requirements List
CHRT	Coordinated Human Resources Technology
CND	Can Not Duplicate
DCP	Decision Coordination Paper
DOD	Department of Defense
DODD	Department of Defense Directive
DODT	Design Option Decision Tree
DPML	Deputy Program Manager for Logistics
DSARC	Defense System Acquisition Review Council
EXPVAL	Expected Value
FH	Flight Hours
FOM	Figure of Merit
HRL	Human Resources Laboratory
HE	Human Engineering

LIST OF ACRONYMS AND ABBREVIATIONS - Continued

TERM	DEFINITION
HI	Human Interface
ITA	Integrated Task Analysis
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
ISD	Instructional System Development
ISP	Integrated Support Plan
JPA	Job Performance Aid
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
LCOM	Logistics Composite Model
LRU	Line Replaceable Unit
LSA	Logistics Support Analysis
LSAR	Logistics Support Analysis Record
M	Maintainability
MAN	Maintenance Action Network
MENS	Mission Element Need Statement
MFHBMA	Mean Flight Hours Between Maintenance Actions
MIL-STD	Military-Standard
MMH	Maintenance Man Hours
MMM	Maintenance Manpower Modeling
MP	Maintenance Plan
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NRTS	Not Repairable This Station
OJT	On the Job Training

LIST OF ACRONYMS AND ABBREVIATIONS - Continued

TERM	DEFINITION
PAGES	Page Estimating Model
PAM	Personnel Availability Model
PDA	Program Definition Analysis
PMD	Program Management Directive
PMP	Program Management Plan
PTIM	Preliminary Task Identification Matrix
R	Reliability
RM	Reliability and Maintainability
RMCM	Reliability, Maintainability and Cost Model
RFP	Request for Proposal
S	Safety
SE	Support Equipment
SOC	System Ownership Costing
SON	Statement of Operational Need
SOW	Statement of Work
SPO	System Program Office
SRU	Shop Replaceable Unit
TAM	Training/Aiding Matrix
TRAMOD	Training Requirements Analysis Model
UAR	Uniform Airman Record
YOS	Years of Service

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CHAPTER 1. INTRODUCTION

1.1 GENERAL

This document is the User's Guide for the application of the ASSET, Acquisition of Supportable Systems Evaluation Technology, to a military weapon system acquisition. ASSET is a systematic, proceduralized methodology that is used to:

a. Provide assessments of cost, human resources, and logistics resources required for support and operation of weapons systems, evaluated during early conceptual phases through production and deployment.

b. Coordinate the development of training programs and technical manuals to ensure complete and cost-effective maintenance performance instructions.

c. Ensure that supportability considerations and human resource impacts are explicitly considered in the design of the weapon system and are traceable.

The application of ASSET to a developing weapon system permits and encourages the early integration of design, logistics support, and operational concepts so that their mutual influence may result in a cost-effective, supportable system. This follows policy guidelines incorporated in Department of Defense Directives 5000.1 and 5000.39 and AFRs 800-2 and 800-8 which emphasize the importance of integrated logistics support planning throughout the acquisition program and especially in the early, conceptual phase.

The ASSET methodology is also in accordance and agreement with the Logistics Support Analysis (LSA) as identified in MIL-STD-1388. In this, LSA is defined as a composite of systematic actions taken to identify, define, analyze, quantify, and process logistics support requirements. This includes those activities that are conducted to evaluate and compare system design and operational characteristics to make objective logistics support decisions. The goal of LSA is to achieve balance between system readiness, operational capability, and logistics requirements at a minimum life cycle cost. The ASSET assists in the achievement of this goal.

1.2 ASSET DESCRIPTION

The significant factors that contribute to successful acquisition or development of cost-effective weapon systems are the identification of support requirements and the identificaiton of cost-reducing alternatives to existing or baseline structures. The ASSET methodology contributes to both factors. The design of the methodology is such that high resource consumers such as manpower, logistics support elements, and other life cycle cost drivers are readily identified upon application of the procedures and models to a baseline or alternative system. Since high consumption areas offer the greatest potential return

for modification efforts, their identification directs design/support engineers to specific subjects for trade-off studies. The ASSET methodology presents detailed comparisons of configuration alternatives in terms of cost and resource requirements.

The basic elements of ASSET are eight analysis procedures, eight analytical computer models, and a single consolidated data base. These are depicted in figure I-1. The application of ASSET revolves around the analysis procedures. The analytical computer models are used as tools to support the procedures. The consolidated data base serves as the single depository of data to support the ASSET application. The procedures and models in ASSET may be applied as an entirety to a complete weapon system or selected portions of the methodology may be used for analysis of specific components of a system. The depth and breadth of application can be tailored by the user, depending upon the scope and constraints of the analysis effort.

The procedures and models provided in the ASSET methodology complement the LSA procedures defined in MIL-STD-1388 by identifying support resources and costs as a result of the ASSET analysis techniques. ASSET also provides procedures for accomplishing tasks which are required or specified by the LSA process but not detailed with respect to technique, such as evaluation of alternatives and defining resource requirements. Finally, ASSET enhances the LSA process by providing modeling capabilities necessary for a thorough LSA including life cycle or system ownership costing.

LSA Records, LSAR, are the documented data of the system design and support requirements, which result from integrating operational requirements and logistics support considerations. The Department of Defense requires that documented LSA be performed on all hardware systems acquired. The Logistics Support Analysis process is continuous from the conceptual stage through production and deployment. However, LSAR, the documented results of the LSA, are not normally prepared prior to full-scale development. LSAR data sheets are generally prepared by a contractor to meet Contractor Data Requirements List (CDRL) specifications. In fact, as stated in DARCOM-P 750-16, LSAR data sheets are not initiated for an item until its configuration is stabilized; that is, not until all design alternatives have been weighed. ASSET thus accompanies and benefits the LSA by providing a means, through its consolidated data base (CDB), to document early design configurations and trade studies. The data in the CDB can then be transitioned to the LSAR at a later time.

The ASSET methodology consists of definition, collection, and processing of appropriate data to meet the functions stated above. In the early conceptual phase, data may be derived from historical files of existing systems to form a baseline for comparison of the new system. As the design of a new system is formulated and feasible alternatives are identified, data are developed for each alternative to assess the associated costs and resources for comparison to the baseline and to

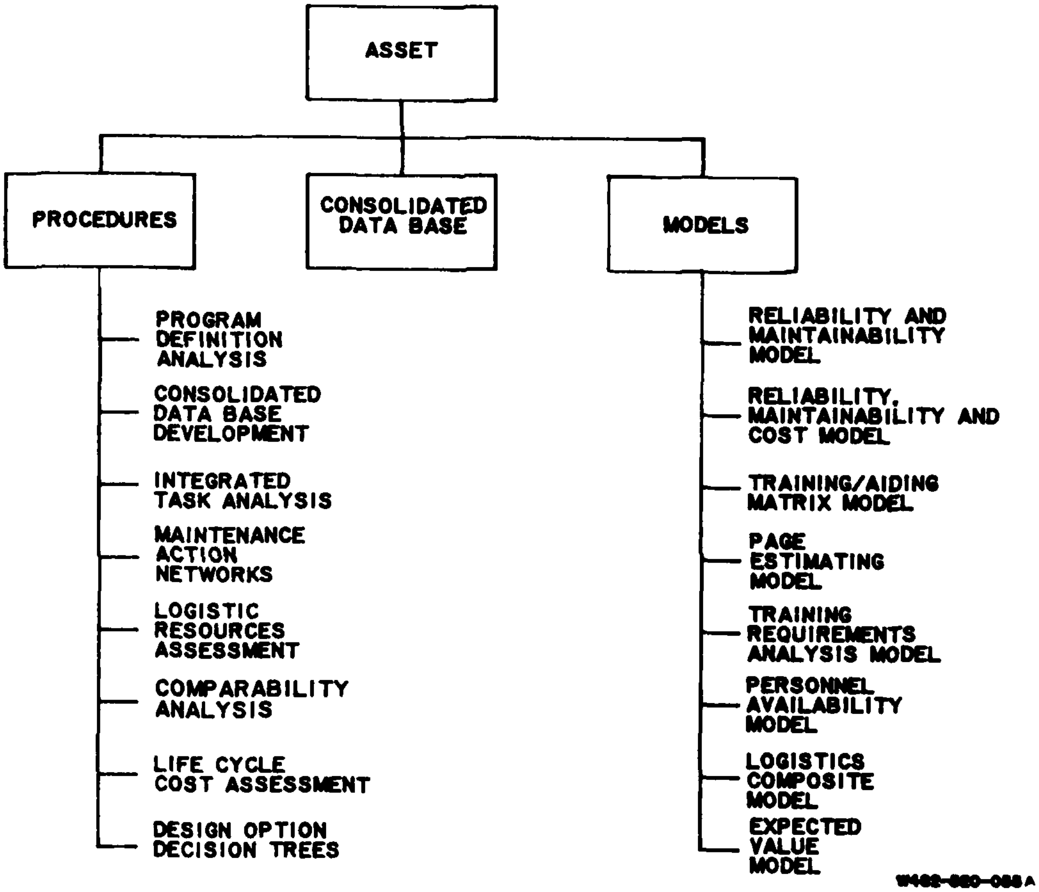

Figure I-1. Elements of ASSET Methodology

each other. This iterative process leads to identification of the least total cost alternative that meets operational performance and logistics requirements and identifies the resources necessary for operation and support of the resulting weapon system.

1.3 GUIDE ORGANIZATION

The ASSET User's Guide is organized into two major books. Book I contains information relating to the general ASSET methodology and to the application of the procedures and associated models to a weapon system acquisition. Book II contains information relating the actual computer operation of the more specific analytical models.

Book I consists of five chapters. The first chapter presents an introduction to the ASSET methodology and to the User's Guide. The second and third chapters contain overviews of the ASSET procedures and analytical computer models, respectively. The fourth chapter presents an integration of the ASSET with a "typical" conceptual phase of a weapon system acquisition program. The fifth and final chapter outlines each analysis procedure.

Book II consists of eight independent chapters, each dealing with a separate computer model. Each chapter is self-sufficient in containing model description, input requirements, operating instruction and output results description for the specific model.

There is also a separate supplement user's guide which contains the source listings for six of the models associated with the ASSET. A model logic flow diagram for each model is also included along with sample input data sets and output reports. Note that ASSET also incorporates two additional existing models, which are well documented, for a total of eight models.

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CHAPTER 2. ASSET PROCEDURES OVERVIEW

This section of the ASSET Application User's Guide contains a generalized overview of the individual procedures incorporated in the ASSET. The integrating ties and relationships between the procedures which unify the methodology are also presented.

2.1 GENERAL

ASSET is applied through a series of procedures which are used to define program requirements, generate and analyze data, and perform trade-offs of design and support alternatives. The procedures which comprise the integral part of ASSET are:

a. Program Definition Analysis Procedure.

b. Consolidated Data Base Procedure.

c. Integrated Task Analysis Procedure.

d. Maintenance Action Network Procedure.

e. Logistic Resources Assessment Procedure.

f. Comparability Analysis Procedure.

g. Life Cycle Cost Assessment Procedure.

h. Design Option Decision Tree Procedure.

These eight procedures are applied consecutively and/or in parallel in an ASSET application, depending on particular program requirements and constraints.

A typical, prototype ASSET application is shown in figure I-2. ASSET concentrates analysis in three of the procedures; the Integrated Task Analysis Procedure, Logistic Resources Assessment Procedure and Life Cycle Cost Assessment Procedure. Through these, the supportability of a weapon system is analyzed for evaluation in terms of logistic resources (including human resources) and life cycle cost. The Maintenance Action Network and Comparability Analysis Procedure provide linkage to the technology and a means for a comparison activity. The Program Definition Analysis Procedure sets the environment for the ASSET application and the Consolidated Data Base (CDB) Procedure provides a CDB for all information collected and generated during the application. The Design Option Decision Tree Procedure presents a method to inject supportability factors and evaluation into the existing DODT methodology.

The ASSET procedures are supported by several analytical computer models developed and modified for use in ASSET. These models are utilized as tools in the performance of the procedures. Figure I-3

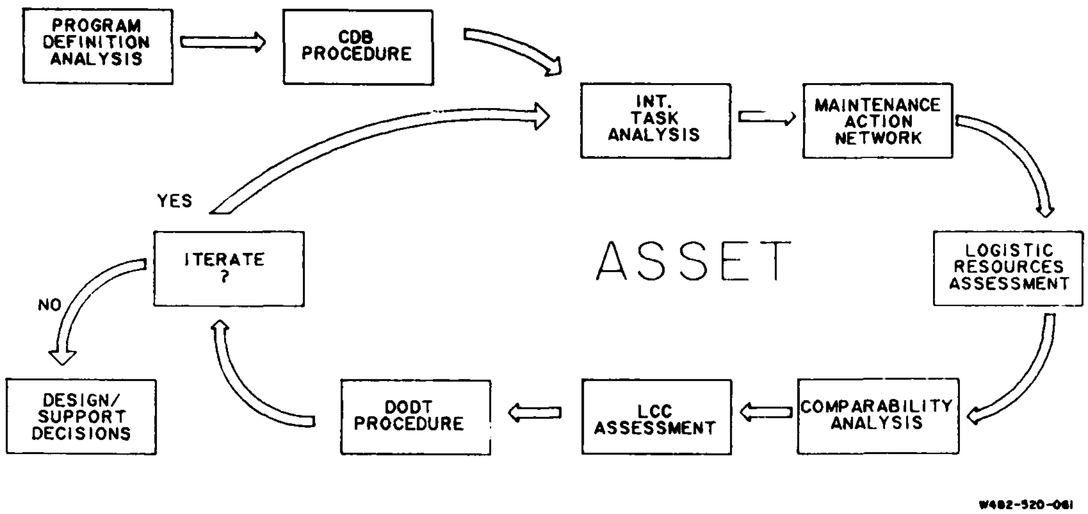

Figure I-2. Prototype ASSET Application

presents a correlation and interface between the ASSET procedures and computer models, showing the models which may support each procedure.

The following paragraphs contain a further description of each procedure and identify the computer models which may be utilized in support of the procedure.

2.2 PROGRAM DEFINITION ANALYSIS PROCEDURE

The Program Definition Analysis (PDA) is the initial effort that must be conducted to put the weapon system (and/or systems of special interest) into context for ASSET application. The specific goals of the ASSET application are well-defined through this analysis effort so that the resources and activity may be limited to achieving those goals.

None of the associated ASSET computer models are directly used in the determination of scope and level of detail to be accomplished during the PDA procedure. Rather, a general knowledge of all the models, such as that presented in Book I, Chapter 3 of this User's Guide, will assist in the selection of appropriate models to support and achieve the goals of a particular application program.

Initially, a review of external data sources is made to establish the program requirements, including a key event and operational readiness schedule, and a detailed phased schedule. Both contain the production and operational planning information necessary to perform resource and cost assessment. The prime data source from which these schedules may be developed is the weapon system Program Management Plan, which contains the planning, responsibilities, management techniques and controls required during the weapon system acquisition process.

The support plans, a series of basic statements describing the ILS elements and reflecting the latest ILS decisions, are also identified. This information is used as a guide in the development of the maintenance action networks because these networks must reflect the planned methods of maintenance support as well as the appropriate maintenance actions. In some cases, it may be necessary to provide a support plan for each subsystem. For example, separate support plans may be desirable for engines and avionics.

Data files are established to include the program requirements and support plans as well as information on maintenance activities, deployment and system use, the operations schedule, and a preliminary listing of alternatives. Simultaneously, the system design data files are established with equipment configuration data, and the preliminary information required to analyze alternatives and to prepare design option decision trees (DODTs), when required, is obtained.

In summary, the PDA procedure identifies the applicable weapon system design and support requirements. A general methodology is followed to identify applicable ASSET procedures and models. Included is the data research effort required to identify the characteristic data elements which define the weapon system program. As the first step in the ASSET package, it contains an extremely important process for initializing the application of ASSET.

2.3 CONSOLIDATED DATA BASE PROCEDURE

ASSET is supported by a Consolidated Data Base (CDB) which is prepared for the weapon system under consideration. The data base contains, at a single location, all information required to analyze the human resource and support impacts during the weapon system acquisition process. The CDB procedure sets forth a definition of the CDB and presents requirements for its administration and control. The CDB procedure does not usually involve the use of the computer models. However, data required by these models will be contained in the CDB.

The CDB is established and maintained to support the application of ASSET during weapon system acquisition and may be transitioned for use in operational and support planning after deployment. The CDB contains data gathered and generated by all the ASSET procedures as shown in figure I-4. This includes the files and data elements necessary for the determination of the human resource considerations related to specific designs and alternatives, the identification of designs and policies which create excessive human resource demands, and the development of the instructional system development and job guide

PROCEDURES \ MODELS	RM	RMCM	TAM	PAGES	TRAMOD	PAM	EXPVAL	LCOM
PROGRAM DEFINITION ANALYSIS PROCEDURE								
CONSOLIDATED DATA BASE PROCEDURE								
INTEGRATED TASK ANALYSIS PROCEDURE	X	X	X	X	X	X	X	X
MAINTENANCE ACTION NETWORK PROCEDURE	X	X					X	X
LOGISTIC RESOURCES ASSESSMENT PROCEDURE	X	X	X	X	X	X	X	X
COMPARABILITY ANALYSIS PROCEDURE				X				
LIFE CYCLE COST ASSESSMENT PROCEDURE		X		X	X	X		
DESIGN OPTION DECISION TREE PROCEDURE	X	X	X	X	X	X	X	X

Figure I-3. ASSET Procedure - Model Correlation

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development products. The CDB will also contain system ownership cost data which will use the human resource parameters to provide system ownership cost and total life cycle cost (LCC) predictions.

The CDB is established immediately after the PDA and in many cases in conjunction with the PDA. It is initially developed from historical and comparative data. It can then be updated with current acquisition information as it becomes available. The CDB in the ASSET process can contribute to the logistic support analysis (LSA) in an acquisition program and provide data for the formal LSA Record. If the particular weapon system acquisition program does not specify LSA, then the CDB can stand alone. In either case, the CDB provides for the earlier documentation of more specific data, derived through a rational process, than has been possible with existing techniques.

The consolidated data base is required to support the application of ASSET on a weapon system acquisition program. The CDB may also be used independently for operational and support planning after deployment or may be transitioned into a LSA Record (LSAR) data base. The consolidated data base is unique to each weapon system. It expands in detail with time as the weapon system acquisition progresses. The CDB is dynamic, representing alternatives being considered as well as baseline approaches and is designed for frequent update and expansion. The CDB also provides a means for historical traceability on the weapon system development process. As the system acquisition proceeds from design through development, the CDB is improved in accuracy and detail by replacing planning and historical information with information acquired on the actual system.

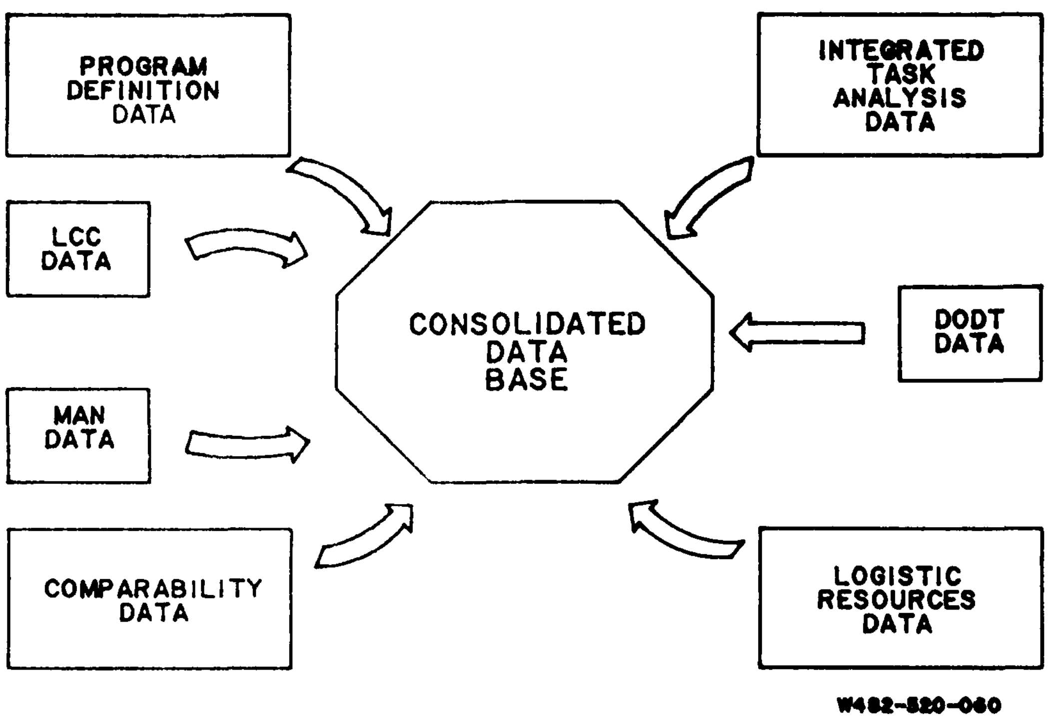

Figure I-4. Data Flow Into the CDB

2.4 INTEGRATED TASK ANALYSIS PROCEDURE

The Integrated Task Analysis Procedure in ASSET outlines a systematic study of the requirements for tasks which must be performed to operate and maintain a weapon system. Results of the task analysis help in the determination of training objectives and of the behaviors and tasks a technical manual must support. This lays the foundation for the development of coordinated training and technical manual products. Results are also used in the logistics resource assessment and life cycle cost assessment procedures.

The integrated task analysis procedure identifies tasks and requirements presented by a weapon system. This analysis may benefit from the use of the analytical computer models associated with ASSET. Models applicable to a task analysis include:

a. Reliability and Maintainability (RM) Model.

b. Reliability, Maintainability, and Cost Model (RMCM).

c. Training/Aiding Matrix (TAM) Model.

d. Page Estimating (PAGES) Model.

e. Training Requirements Analysis Model (TRAMOD).

f. Personnel Availability Model (PAM).

g. Expected Value (EXPVAL) Model.

h. Logistics Composite Model (LCOM).

The selection of individual models for use is an option of the user or analyst. Not all of the models listed above may be applicable. For example, the RM model, EXPVAL model and LCOM all analyze tasks required to support a weapon system. LCOM is a simulation model while the RM and EXPVAL models are mean or average value models and require differing inputs. Thus, an analyst may elect to choose only one of these three models for a particular application program.

There are essentially two levels of task analysis: (1) the initial task identification, and (2) the subsequent detailed analysis of the identified tasks. The initial task identification results are recorded on the preliminary task identification matrix (PTIM). The subsequent detailed analysis is documented on task analysis work sheets. The test equipment and tool utilization is also documented on the work sheets with information gained from the detailed task analysis. Later, information is extracted and recorded on an annotated task identification matrix (ATIM).

The first steps in the task analysis procedure are to develop a listing of the hardware components of the weapon system to the level at which the tasks are performed and to identify and determine the initial allocation of maintenance tasks with regard to the equipment breakdown.

This is documented on the PTIM. The maintenance level at which the task will be performed is also recorded in the PTIM.

The next step in the procedure is the specific task analysis and the completion of the task analysis work sheets. These work sheets are completed to describe the specific tasks in detail. The purpose of this is to identify and verify hardware elements and maintenance task steps, describe the cue and accompanying responses for each step, list the tools and equipment used, and to evaluate the safety hazards and environmental factors related to each task. Throughout the actual task analysis and the completion of the task work sheets, the analyst must refer to the user description and the set of ground rules describing the task scope and detail to be documented on the work sheets.

The ATIM is a later revision or update of the PTIM. The task identification matrix is updated to document the hardware components and corresponding tasks identified through the task analysis and is revised to specify the authorized maintenance level at which each task will be performed. The matrix can also be annotated (thus the name ATIM) with information documenting the results of the training/technical manual trade-offs. Specifically, each task can be identified as to whether the task information emphasis should be placed on training (head), manuals (books), or jointly on both.

A final item of the ASSET integrated task analysis is a level of detail guide. This guide is established to assist in the actual technical manual preparation. It contains specific guidelines for the material to be included in the manuals and the depth of detail regarding task procedures.

2.5 MAINTENANCE ACTION NETWORK PROCEDURE

The Maintenance Action Network (MAN) Procedure is used for depicting the maintenance flow of a system and for defining the input data used in the application of ASSET as an assessment methodology. The maintenance action network describes the maintenance system in terms of resources required to carry out the maintenance functions necessary to restore a system to operational readiness. This network uses an event tree structure which defines the maintenance events that result when a particular subsystem has indicated a malfunction and requires a maintenance action. The networks can be used by themselves to understand a weapon system and its support options. They can also serve as an input data resource for the ASSET models.

The data represented on the maintenance action network is used by the following models:

a. Reliability and Maintainability Model.

b. Reliability, Maintainability and Cost Model.

d. Expected Value Model.

e. Logistics Composite Model.

The level of detail required and complexity of the network possible for each model is not constant and can thus indicate which model to use for a particular application.

The basic maintenance action network is depicted in figure I-5. This subsystem network represents the unscheduled maintenance actions which may occur and could be used to represent the maintenance actions for equipment such as a radar subsystem of the avionics system. Presently in the methodology, maintenance actions are performed either at the organizational (flightline) or intermediate (shop) level. Depot level maintenance is related through the not-repairable-this-station (NRTS) branch. This network structure can be expanded if it is to cover the three common levels of maintenance in more detail. With minor modification, this format may also be used to represent scheduled maintenance.

Each node in the network representation indicates the beginning and/or end of a specific event such as subsystem failure, set up support equipment, or troubleshoot. With the exception of subsystem failure, each event is annotated to indicate (1) the probability that the

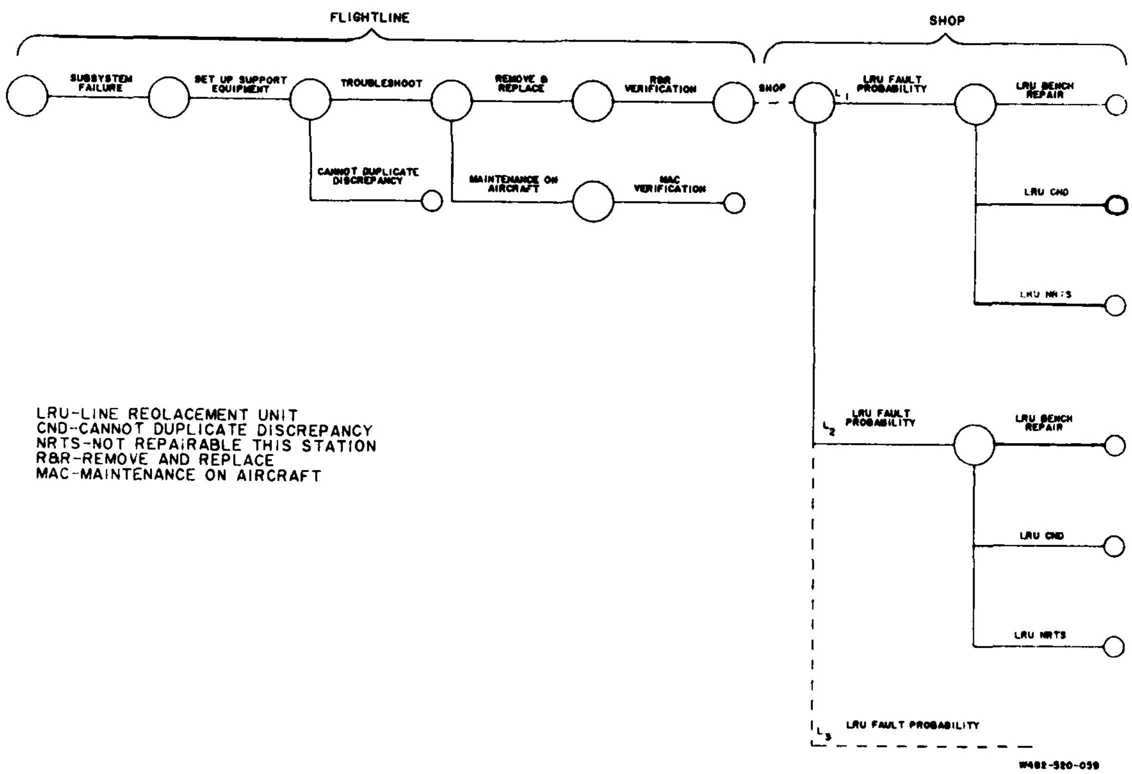

Figure I-5. Basic Maintenance Action Network

event will occur, (2) the time to complete the event, (3) the maintenance personnel characteristics (skills, levels, and quantity) to support the event, and (4) the support equipment (type and quantity) required to support the event. Subsystem failure is annotated only with the probability of occurrence.

The maintenance action network identifies the possible maintenance outcomes associated with a subsystem or LRU failure. Associated ASSET models can then compute the total demand on the maintenance system by multiplying the support resources required per event by the average frequency of event occurrence and then summing across all maintenance events associated with the equipment hierarchy. Support resources are defined in terms of crew size, skill categories, skill levels, support equipment, and average time required to complete the tasks associated with the event. Event frequency is defined simply as the per flight hour probability of that event occurring. The network has a flexible structure that can be tailored for modeling applications. Additional model inputs from the modified network are then needed to handle the additional data.

The data used to annotate these networks in the early acquisition phases are developed from an analysis of historical data on comparable equipment. This analysis is partially judgmental and must consider the source of the historical data and the intended application of the proposed system. Historical data is gradually replaced with actual subsystem data as the hardware is designed, built, and tested and usage data is collected. The networks, therefore, grow from an estimated to an actual model of the maintenance system.

As previously mentioned, the data represented by this network is used by the RM model or the Logistics Composite Model (LCOM) to determine the manpower and support equipment resources required to support the maintenance system. The complexity of the network reflects the availability of data and interest in the equipment. LCOM is normally used where a system configuration is firmly established, where the operational scenario is known, and where the dynamics of the personnel and support equipment requirements are required to be known.

The RM model uses a simplified maintenance action network consisting of up to seven flightline and three shop tasks. Complex networks can then be formed when the simplified networks are extended, as they are in LCOM, to include additional tasks, parallel tasks, and tasks with multiple records. In a simulation using LCOM, the maintenance action networks must obey a set of rules for construction of a network, but need not adhere to any specific predefined form.

Maintenance action networks form the underlying structure to the tasks analysis procedure and the models included in ASSET. The networks can aid the designer in graphically displaying the events and options available for support of a design in much the same way the DODT describes design alternatives. It is not, however, necessary to explicitly form a maintenance action network for every application of ASSET. The procedure, however, is valuable in understanding the underlying structure of the models, can focus and direct the data collection

efforts, and provides a graphical tool for presenting support options. The early application of the MAN procedure is especially useful as a first step to later use of the LCOM when detailed data become available. The maintenance action network approach is the basis for LCOM analysis and its early application in ASSET will ensure that the required data, in the proper form, will be developed during the acquisition process.

2.6 LOGISTIC RESOURCES ASSESSMENT PROCEDURE

The logistics resources assessment procedure is used to identify, evaluate and challenge the logistic resources requirements posed by a weapon system. Logistic resources include such items as manpower, skills, tools, support equipment, spares, facilities, training and technical manuals, and impact the total support of the weapon system.

The logistic resource assessments are provided by the application of several elements which are part of the ASSET package. Quantitative information in these areas results from the application of the methodology. The value of logistic resource assessments in planning for, or in designing of, a weapon system has been established by the many maintenance models in use and the LSA process. There are many ways to accomplish this and many techniques, models, and data systems to assist in its accomplishment. To provide the user with the assessment capability, ASSET includes several options within the models, and the information contained in the consolidated data base, which can also be used to support the formal LSA and LSAR. The model options used depend upon the specific problem being investigated and the analysis technique(s) selected for application.

The logistic resources assessment procedure may utilize any or all of the eight models associated with the ASSET. Some models emphasize particular resources and thus the use of the model is dependent on whether that resource is of interest to a particular application program. Examples of this are the TAM model which addresses training versus manual content for tasks and the PAGES model which addresses technical manual page estimates.

Feasibility demonstrations performed as part of the ASSET evaluation provided logistic resource assessment information and showed how quantitative results can achieved and used to influence design. The logistic resource data provides maintenance-specific information which is particularly useful in gaining an understanding of the support requirements for a weapons system.

2.7 COMPARABILITY ANALYSIS PROCEDURE

The comparability analysis procedure is the overall process in ASSET used to develop data on newly proposed or designed weapon systems by (1) selecting operational equipment similar to that of the proposed weapon system and (2) adjusting the resource data associated with operational equipment to reflect the unique characteristics of the proposed equipment. The comparability analysis includes the development of maintenance demand rates for the proposed equipment which, in turn, can

be used to determine resource requirements (such as manpower, support equipment, and spares for the weapon system). It also includes a systematic procedure for finding operational equipment that is similar to the proposed equipment.

The use of the PAGES model may assist in performance of the comparability analysis. This model estimates the number of technical manual pages required to document maintenance tasks. The estimation can then be used for comparison with similar systems or subsystems.

A comparability analysis is initiated using the outline of the hardware/configuration/characteristics data file as a starting point. The comparability concept is also extended to address software, operator tasks, and training. The first step after the selection of a baseline system is to identify new, eliminated, or reallocated operational tasks in a preliminary task list. This might be accomplished by a mock-up task analysis. The maintenance training and operator course material data files are then established using comparable training course data for the required skills. Course and task data are used in resource assessment to estimate training requirements. Other information which may be used to assess resources such as facilities, manpower, and system ownership cost are also estimated using the baseline comparison system.

Comparability analysis is the keystone to application of ASSET in early system design. Existing documentation outside of ASSET provides a procedure for applying this concept to hardware. In addition, well-defined data sources for this extended information must be identified and require searching and development by the analyst performing the ASSET application.

2.8 LIFE CYCLE COST ASSESSMENT PROCEDURE

The life cycle cost (LCC) assessment capability within ASSET is provided by the application of the Reliability, Maintainability and Cost Model (RMCM). The value of life cycle cost assessments in planning for, or in designing of, a weapon system has been established and there are many Life Cycle Cost models in use. There are many ways to accomplish LCC assessments and many techniques, models, and data systems to assist in its accomplishment. ASSET presents several options within the RMCM and includes the information contained in the consolidated data base to provide the user with a tool for LCC analysis. Again, the option used depends upon the specific problem being investigated and the analysis technique selected for application.

In addition to the LCC assessment provided by the RMCM, information provided by several other models may be beneficial for a particular application program. These models include:

a. Page Estimating Model.

b. Training Requirements Analysis Model.

c. Personnel Availability Model.

Results from these models may be used as inputs in the LCC assessment when other data is not available or may be used to validate data collected from other sources.

The life cycle cost detail provided by ASSET is comparable to that of several models which have been successfully used. Cost adjustments and perturbations are also supported by the ASSET which enables various sensitivity analyses to be conducted.

2.9 DESIGN OPTION DECISION TREE PROCEDURE

The Design Option Decision Tree (DODT) is an existing methodology which is documented and has been applied in the study of several proposed and existing weapon systems. ASSET includes a DODT procedure which interfaces with the existing DODT methodology and injects supportability estimates and evaluations to assist in alternate design and/or support decisions.

All eight of the computer models associated with ASSET may be used within the DODT procedure. These models address supportability considerations useful in the evaluation of alternatives as identified in a DODT. Use of individual models is an option of the analyst and is dependent on the particular requirements of an application program.

The design option decision tree, DODT, provides a means of accounting for the many trade-offs that are performed during the course of a system design effort and identifying the critical decision points during design. Specifically, the DODT is a graphic means of depicting the sequence of engineering decisions required for resolution of a design problem and describing the design options available at each decision point. DODTs can be prepared to various levels of detail, depending upon the specific problem analysis required. A complete breakdown can go to the detailed "hardware" level; however, the tree can be developed to whatever level of detail is required for the particular system.

Some factors which influence the decision options are the performance requirements of the system, logistics, weight, cost, reliability, and development risk. Human resources data, related to personnel, training, and maintenance impacts, can be added as a system requirement, and would then become factors in the choice of alternatives and be shown on the DODT. As design options, these data can include quantity of personnel required to perform maintenance troubleshooting on the equipment, job specialty of the maintenance personnel, time to troubleshoot a failure in the equipment, ease of maintaining the equipment, and complexity of tools required to perform maintenance work on the equipment.

Within the DODT format, a numerical evaluation scheme can be established by assigning a scale rating to each of the design parameters of interest, including weight, actual cost in dollars, performance, development risk, human resources, and logistics support. A scale rating can be given to each branch of a decision node of the DODT. These numerical scale ratings allow a quantitative determination

of the best path through the tree. The scale rating scheme provides an easily implemented method for the designer to evaluate choices within the DODT, and to quantify the alternatives involved in making design decisions. The scale ratings for each of the areas can be derived from historical data, results of experiments, or mathematical modeling. In addition to the scale ratings applied to the design options in the tree, there can also be a confidence level for feasibility of engineering development assigned to each option for new technology areas both in design as well as in related support.

DODTs are used in ASSET to depict the overall system and critical subsystems. The general system level is important because the trade-offs normally depicted have significant life cycle impact and should be performed early in the acquisition process. In addition, the general system tree is helpful in identifying critical subsystems.

When it is decided to use DODTs, subsystem DODTs should be developed as early as possible for critical subsystems. These critical subsystems will be identified during system design and are usually critical to all missions, have many operating elements, receive heavy use, or have many inherent alternatives. ASSET extends the DODT concept to the design of support systems and a logistics option tree is used for each system to document the baseline approach and to identify viable alternative logistics concepts.

In a trade study which can be done by the repeated application of the ASSET tools and techniques, the design options are defined in detail, and analyzed using a number of engineering and support factors. Resolution of the trade-off is achieved by mathematically combining the data for each design alternative into a composite score, and selecting the alternative with the "best score". This leads to the comparison of alternatives and to the eventual selection of a design approach.

In summary, DODTs provide a clear method of showing choices, a traceable record of decisions made, and a rationale for making the decisions. The DODT approach tends to indicate that all relevant decision paths have been depicted and so must be carefully applied to problems that can be bounded by a DODT. Depending on their complexity, a significant amount of labor may be necessary to generate elaborate trees containing many nodes and branches. Each problem must be reviewed to establish the requirements for and the benefits to be derived by generating and using DODTs. The DODT must be applied properly and in consideration of the problem under evaluation. The technique works with ASSET in the applications where the problem set can be properly bounded and depicted by a set of alternative actions and decision choices.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 3. ASSET MODELS OVERVIEW

This chapter of the ASSET Applications User's Guide contains a generalized overview of the individual computer models incorporated in ASSET to facilitate the various quantitative analyses required by the procedures.

3.1 GENERAL

Associated with ASSET are eight computerized models which support the decision-making processes. These models are listed below:

a. Reliability and Maintainability (RM) Model.

b. Reliability, Maintainability, and Cost Model (RMCM).

c. Training/Aiding Matrix (TAM) Model.

d. Page Estimating (PAGES) Model.

e. Training Requirements Analysis Model (TRAMOD).

f. Personnel Availability Model (PAM).

g. Logistics Composite Model (LCOM).

h. Expected Value Model (EXPVAL).

The first six models listed were developed in support of avionics design efforts. These have been modified and are incorporated for ASSET application. The last two models listed were developed independently and presently are accepted and utilized in the logistics community.

The analytical computer models are tools which may be used in varying combinations during the performance of the ASSET procedures. Figure I-6 shows the interrelationship between the ASSET procedures and computer models. This is presented as a suggested guide for viewing the ASSET methodology framework and may be modified for individual application program requirements. The selection of individual models for use in a particular application program is an option of the user.

The synthesis of the procedures and computer model tools into a unified ASSET application defined by the user permits the accomplishment of the ASSET goals identified early in Chapter 1.

The following paragraphs describe each of the eight computer models and identify the procedure(s) which may benefit from the use of these tools.

MODELS / PROCEDURES	RM	RMCM	TAM	PAGES	TRAMOD	PAM	EXPVAL	LCOM
PROGRAM DEFINITION ANALYSIS PROCEDURE								
CONSOLIDATED DATA BASE PROCEDURE								
INTEGRATED TASK ANALYSIS PROCEDURE	X	X	X	X	X	X	X	X
MAINTENANCE ACTION NETWORK PROCEDURE	X	X					X	X
LOGISTIC RESOURCES ASSESSMENT PROCEDURE	X	X	X	X	X	X	X	X
COMPARABILITY ANALYSIS PROCEDURE				X				
LIFE CYCLE COST ASSESSMENT PROCEDURE		X		X	X	X		
DESIGN OPTION DECISION TREE PROCEDURE	X	X	X	X	X	X	X	X

Figure I-6. ASSET Procedure - Model Correlation

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3.2 RELIABILITY AND MAINTAINABILITY (RM) MODEL

The Reliability and Maintainability (RM) Model provides outputs of R&M parameters in a form useful for initial studies and trade-off analyses in the conceptual acquisition phase. The input consists of reliability and maintainability parameters of the weapon system. The output includes information useful to the system designer in identifying high support resource consumption areas upon which to focus cost reduction system design efforts. In view of the fact that system support factors affect a significant portion of the system life cycle cost, the RM model focuses on calculating estimates of mean-time-to-repair (MTTR), maintenance manhours, and system and subsystem availability based on the underlying system and support concept.

The RM model provides useful information for the performance of the following procedures:

a. Maintenance Action Network Procedure.

b. Integrated Task Analysis Procedure.

c. Logistic Resources Assessment Procedure.

d. Design Option Decision Tree Procedure.

The model verifies the assignments of factors on the branches of the maintenance action network and provides measurements of resource usage for task analysis and resource assessment. The model may also be valuable in quantifying advantages of alternate options in a DODT application.

Rapid computational ability was a primary design feature of the RM model because numerous trade-off studies are conducted during the development of new avionics systems and, therefore, many iterations of the model would be needed. This was accomplished by designing an average value model. Total demands on the support system are computed by multiplying the average support resources required per event by the average frequency of event occurences and then summing across all maintenance events associated with the equipment (or system) repair.

In order to use the RM model, it is necessary to start with a system breakdown structure (hierarchy) with up to five levels of indenture selected by the model user (see figure I-7). The selection must be made with care to ensure that the indenture levels are consistent across the system and that aggregation of data is meaningful for the specific levels.

The next step is to model the operation and maintenance (O&M) process. Due to the requirement for computational speed, the R&M model was based upon a simplified representation of that process. Basically, the operational scenario creates a demand upon the maintenance system as a function of the number of sorties or flying hours and the failure rates of the individual subsystems or units in the avionics suites. The RM model computes the demand placed on the maintenance system on a

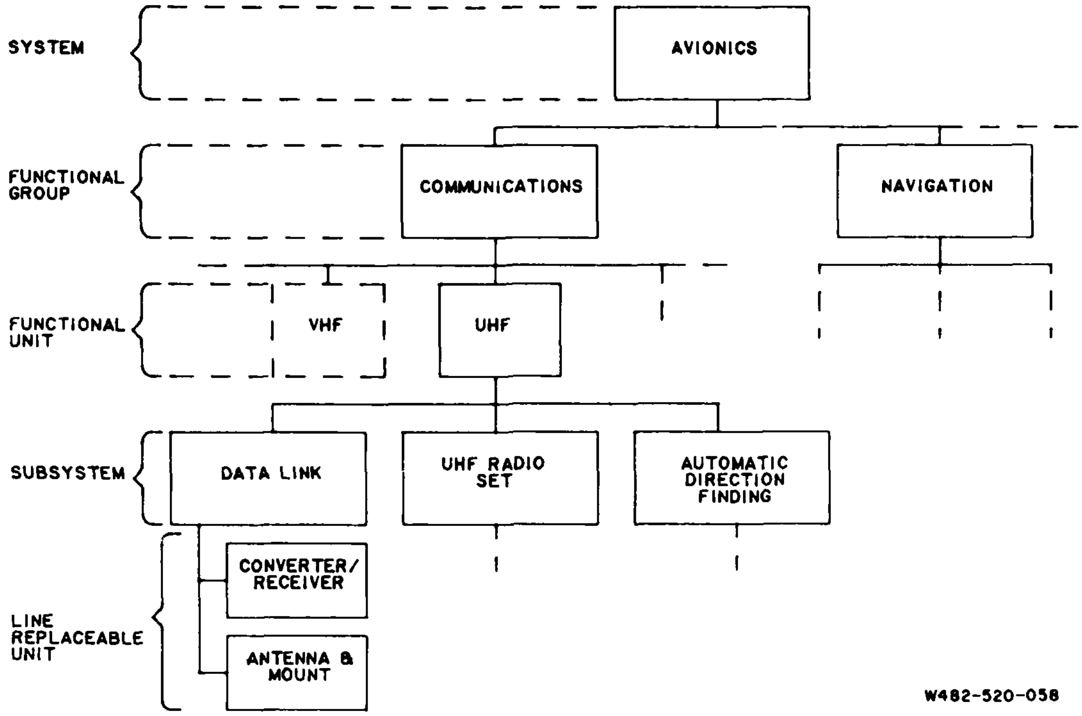

Figure I-7. Example of Avionics Suite Hierarchy

subsystem or LRU basis, and therefore treats the operational scenario in terms of the mean flying hours between maintenance actions of individual LRUs. This mean value of demand on the maintenance system is for assessment of life cycle support resources during the initial phases of the acquisition process.

Given that a demand is placed upon the maintenance system, the maintenance process must restore the equipment to operational readiness. The maintenance process is modeled in terms of on-equipment and off-equipment events. The maintenance process is initiated by a discrepancy report or indication on the part of the aircrew or maintenance personnel that a malfunction exists. The model distinguishes between actual failures and human (or equipment) errors which later result in a "cannot duplicate" (CND) condition. However, since both result in a demand for maintenance resources, the failure frequency is based on all discrepancy reports which trigger subsequent maintenance events on the flightline.

The model considers generic events consisting of one or more maintenance functions (i.e., adjust, align, calibrate, troubleshoot, inspect, operate, remove/install, repair, service, etc.). The support resources associated with each maintenance function are also aggregated at the event level. Although not precisely adjusted for each detail, results are sufficient for the purpose of assessing support requirements in the early stages of the system acquisition process. The possible flightline maintenance events are:

a. Set up flightline support equipment.

b. Troubleshoot.

c. Troubleshoot a cannot duplicate (CND) discrepancy.

d. Remove and replace.

e. Minor repair on the equipment.

f. Verify replacement correcting discrepancy.

g. Verify minor on-equipment repair correcting discrepancy.

Support resources required per event at each level must be provided as inputs to the RM model. They are defined in terms of crew size, specialty codes, skill levels, support equipment, and average time required to complete the tasks associated with the event.

The detailed reliability and maintainability information can be expressed in terms useful to system designers during the early phases of system acquisition. The fundamental concept is to define a measure of support resource requirements, evaluate this measure for each element of the total system, and then rank each element in the system in terms of the measure. The ranking identifies the relative impact of each element in the system on support requirements. This information focuses the designer's attention on potential problem areas so that action can be taken to avoid future costs.

Three measures, called figures of merit (FOMs), are calcuated by the model. These are (1) mean time to repair (MTTR) per 1000 flight hours, (2) maintenance manhours (MMH) per 1000 flight hours, and (3) flightline system availability. The first two FOMs are utilized to measure the impact on maintenance resource requirements, while the third measures the maintenance impact on operational readiness. These FOMs are sufficient for most analyses although other metrics could be developed to enhance the model capability. Some FOMs which should be considered are support equipment utilization, logistics downtime, turnaround time, or sparing effectiveness.

The underlying maintenance structure in the RM model is based on generalized maintenance action networks. The following is a brief description of this process.

The initial maintenance event is to set up the necessary test equipment and power sources at the flightline and exercise the subsystem that has a discrepancy. If a failure has occurred, a troubleshooting event will locate the cause of the malfunction. In some instances, the apparent failure cannot be duplicated and the maintenance activity will terminate as a cannot duplicate (CND) disposition. The flightline troubleshooting event normally isolates the malfunction to a line replaceable unit (LRU). Depending on the nature of the malfunction, it may be necessary to remove an LRU and send it to the field shop for repair. If this is done, the aircraft is put back into service by replacing the faulty unit with a functioning one from spares stock. Alternatively, it may be possible to effect the needed repair on the aircraft by a minor maintenance activity such as alignment, calibration, etc. In either case, a verification event is required to provide assurance that the procedure has, in fact, corrected the problem.

Two sets of mutually exclusive, parallel events have been noted above for on-equipment maintenance. In terms of the utilization of maintenance resources, it is necessary that the probabilities of these parallel events be determined. Furthermore, since the events are mutually exclusive, the sum of the probabilities of each pair of parallel events will equal unity.

While on-equipment maintenance is concerned basically with the system repair, shop maintenance (off-equipment) deals with individual LRUs removed from the aircraft. The resources demanded at this maintenance level are also functions of failure frequency. This is indicated by the LRU fault occurrences given in maintenance actions per flight hour. The possible maintenance events that can be conducted at the intermediate shop will then be:

a. LRU bench check and repair.

b. LRU bench check OK (shop CND).

c. LRU not repairable this station (NRTS).

The LRU bench check and repair encompasses a troubleshooting activity as well as subsequent part replacement, calibration, adjustment, and additional functions necessary to bring the LRU to full operating status. The shop CND result which sometimes occurs is due to the fact that fault isolation at the flightline is imperfect and may lead to a functioning LRU being sent to the shop. On the other hand, the flightline procedures may only isolate the malfunction to a group of LRUs so that all have to be sent to the shop.

The not repairable this station (NRTS) disposition is used to describe the maintenance event which results in shipping a unit to another maintenance echelon where greater capability exists for testing and repair. The units shipped may be either LRUs or shop replaceable units (SRUs). If the intermediate shop does not have the capability to maintain a specific LRU, it will be shipped to depot. In other instances, the base shop will remove and replace malfunctioning SRUs

which will then be shipped to the appropriate depot if they cannot be serviced at the base.

3.3 RELIABILITY, MAINTAINABILITY, AND COST MODEL (RMCM)

The Reliability, Maintainability, and Cost Model (RMCM) estimates life cycle costs of weapons systems. A primary feature of the RMCM is that it is operated interactively from a computer terminal and allows the user to perturb data for instantaneous sensitivity analysis.

The RMCM calculates a life cycle cost (LCC) value for the weapon system defined to the model through a set of equipment, reliability, maintainability and cost factors. The LCC value may be useful for comparison and evaluation in the performance of the following procedures:

a. Maintenance Action Network Procedure.

b. Integrated Task Analysis Procedure.

c. Logistic Resources Assessment Procedure.

d. Life Cycle Cost Assessment Procedure.

e. Design Option Decision Tree Procedure.

RMCM consists of distinct elements that have been chosen to capture relevant costs associated with investment, operation, and support of a system. The model applies cost factors to the assessed resource values generated by algorithms from the RM model and then combines the results with other cost elements and cost algorithms to estimate total LCC. The outputs are presented in selected combinations or summary form as requested by the user. The cost elements represent a complete set of factors that are required to accurately evaluate life cycle costs.

The cost elements are aggregated by a major cost category structure with three principal cost categories -- nonrecurring, recurring, and system disposal. Although system disposal is, by definition, a nonrecurring cost, such costs are considered separately by the model. The hierarchical structure of these cost elements, in terms of their contributions to the LCC categories used to catalog them, is shown in figure I-8.

The interactive RMCM program performs four major functions: R&M computation, cost computation, R&M perturbation, and cost perturbation. After preparing R&M and cost data banks, the user exercises the model in one of several operational modes which uses a combination of the functions listed above. The simplest mode of operation is the basic computation of reliability, maintainability, and cost output parameters. The input R&M parameter values, the same as those utilized by the R&M model, and cost factor values from the cost data bank are used as inputs to the cost equations. Cost outputs are then calculated using the cost algorithms and are available to the user through the interactive terminal or through the batch mode print program.

To study the sensitivity of an R&M parameter on LCC, the user may alter an R&M parameter and create a second "perturbed" R&M file. The cost equations are then evaluated for both configurations simultaneously, with comparative outputs available to the user. Similarly, it is possible to vary cost parameters. The user may modify any variable from the cost data file, any output from the R&M computations, or any combination of both prior to calculation of the cost outputs. Finally, both the R&M and the cost files can be perturbed when performing sensitivity and trade-off analyses. The resulting perturbed outputs reflect the combined effects of changes in both R&M and cost values relative to the baseline (original data) outputs. The sensitivity analysis capability is convenient for making ready comparisons and can provide visibility for the various tradeoff considerations.

3.4 TRAINING/AIDING MATRIX (TAM) MODEL

The Training/Aiding Matrix (TAM) presents an assessment of training and technical manual information relevant to the acquisition of a weapon system or subsystem. TAM provides information content requirements in terms of the degree of coverage required in training and/or technical manuals for both flightline, troubleshoot and non-troubleshoot, plus shop repair tasks. The output of the TAM program consists of the training/aiding matrix. The elements of this matrix are ratios of the weight of the training requirements to the technical manual requirements (sometimes referred to as the head-book trade-off).

The training and technical manual content information provided by the TAM model may be useful in the following ASSET procedures:

a. Integrated Task Analysis Procedure.

b. Logistic Resources Assessment Procedure.

c. Design Option Decision Tree Procedure.

The TAM technique is embodied in a program which is a collection of algorithms utilized to present the training and technical manual information. This information is presented in a matrix format with the system hardware hierarchy forming the rows of the matrix and three basic types of tasks forming the columns. These tasks are troubleshoot on the flightline, non-troubleshoot on the flightline, and repair in the shop. The first two are considered at the subsystem level. The third is considered at the LRU level. The degree of information coverage for training and technical manuals appears as a ratio read as the training requirements versus the technical manual requirements. A one (1) indicates light coverage required in either area, while a three (3) indicates heavy coverage.

The TAM program is an interactive program requiring basic input data to be provided by the user. This data consists of the name of the system under analysis and the number of subsystems and LRUs in the system along with the names of the subsystems and LRUs. In addition, the user must provide numerical information corresponding to the three

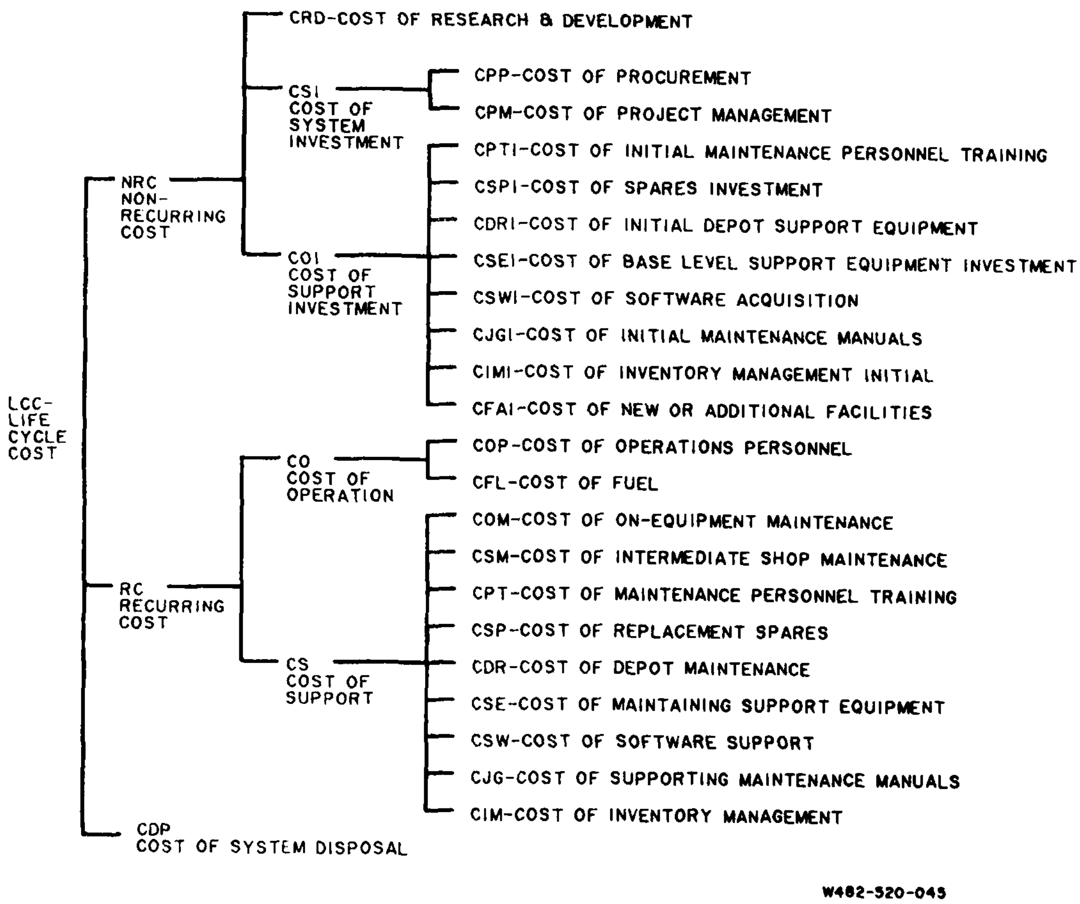

Figure I-8. Life Cycle Cost Hierarchy

types of maintenance tasks -- flightline troubleshooting, non-troubleshooting, and shop repair -- to be used in statistical analysis in ranking each task. After this data is provided to the program for each subsystem and LRU, the user is requested to answer questions posed by the program relating to the statistical analysis and ranking of each task.

The assessment of training and technical manual information content has typically been accomplished in the mid- to full-scale development phase. ASSET encourages the earlier initiation of investigation in this area through the integrated task analysis procedure. There are advantages to assessing training and technical manual information content earlier during the acquisition program. Such an assessment could be used to:

a. Prioritize the training and technical manual coverage areas.

b. Develop training and technical manual statements of work.

c. Alert training and technical manual specialists to the possibility of extraordinary product needs.

d. Identify areas for training/technical/support equipment tradeoffs.

3.5 PAGE ESTIMATING (PAGES) MODEL

The technical manual page estimating model (PAGES) is used to determine the quantity and types of pages that will be required for both flightline and shop technical manuals in support of a weapon system. Inputs to the model are the type of system and number of composite subsystems, LRUs and SRUs. Output results are estimates of the total page requirements and are qualified as troubleshooting or non-troubleshooting pages such as those found in a checkout procedure.

The technical manual page estimates provided by the PAGES model may be useful in analyses conducted within the following procedures:

a. Integrated Task Analysis Procedure.

b. Logistic Resources Assessment Procedure.

c. Comparability Analysis Procedure.

d. Life Cycle Cost Procedure.

e. Design Option Decision Tree Procedure.

The page estimates are particularly valuable when comparing alternate system designs.

The model algorithms are unique to an equipment category; hence, a set of algorithms is included for electrical and another for mechanical/hydraulic systems. The user selects the appropriate algorithm by answering a user prompt with the type of system under analysis, either electrical, mechanical, or both.

The output of PAGES is an estimation of the number of technical manual pages that will be required for both the flightline and the intermediate shop level. The estimate is presented in a matrix format with the type of page forming the rows and the type of maintenance task forming the columns. The page type includes those shown in figure I-9. The types of maintenance tasks are flightline troubleshooting, shop troubleshooting, flightline non-troubleshooting, and shop non-troubleshooting.

A separate estimation matrix is produced for each of the following classifications of technical manuals and systems as specified by the user:

a. Electronics - conventional.

b. Electronics - task-oriented.

c. Mechanical/Hydraulic - conventional.

d. Mechanical/Hydraulic - task-oriented.

- Narrative
- Half-Tone Art
- Half-Tone Explosion
- Electronic Line Art
- Exploded Line Art
- Fault Isolation Chart
- Fault Isolation Schematic Block
- Access Line Art
- Fault Isolation Schematic Flow
- Fault Isolation Schematic Mech/Hydraulic
- Job Guide Narrative
- Job Guide Illustrations

Figure I-9. Technical Manual Page Types Included in PAGES

The model may be used to estimate either conventional or task-oriented manuals. The conventional manual contains significant theory and is of the general kind procured by the Air Force over the last 15 years. The task-oriented manual is a newer type which is directive in nature and is specified by MIL-M-83495.

The technical manual page estimating model is a tool for use during the evaluation of a new system acquisition for the effect on technical manual requirements. In addition, this program may be useful in the initial preparation of technical manual proposals and in the evaluation of these proposals.

The PAGES model require additional verification/validation to evaluate the applicability of the underlying estimating algorithms to various levels of equipment complexity. Thus, the user must be cautioned to review the model assumptions and algorithms before using this model. This may be accomplished referencing Book II, Chapter 4 of this guide for more detailed information on the PAGES model.

3.6 TRAINING REQUIREMENTS MODEL (TRAMOD)

Analysis of training impacts within the acquisition process is deemed an absolute necessity if weapon systems are to be designed to provide essential capability at minimum affordable cost. TRAMOD can facilitate the rapid estimation of training requirements and the consequences of alternative approaches to fulfilling them. The model provides an aid to weapon system designers and planners in considering the training implications of design. Equally important, TRAMOD permits the training analyst to better understand and quantify the impacts of new systems on training requirements and the options available to fulfill them, in terms of the effects of the design and maintenance characteristics of equipment. This information can then be used to influence the design process. Iterative use of the model, with systematic manipulation of constraint parameters, can refine results and enable the user to examine various concepts. In this way, TRAMOD can accomplish early identification of excessive requirements, investigation of alternative policy decisions, and training cost estimation. Used early in system development, this capability aids in avoidance of unnecessary training expenditures by allowing a user to approach the solution of training problems in terms of their causes.

Training analysis provided by the TRAMOD may be beneficial in support of analyses conducted during the following procedures:

a. Integrated Task Analysis Procedure.

b. Logistic Resources Assessment Procedure.

c. Life Cycle Cost Assessment Procedure.

d. Design Option Decision Tree Procedure.

TRAMOD requires input data relating to the tasks to be performed on the weapon system. The data is fairly detailed with each task being assigned a SCALAR value for each of five characteristics denoting frequency, criticality, learning difficulty, and psychomotor and cognitive levels. The model results describe potential training plans and scenarios.

The training model, TRAMOD, consists of four main components:

a. Training block generator.

b. Training plan generator.

c. Training program generator.

d. Training analyst.

Figure I-10 illustrates the main components of the training model concept. The TRAMOD analysis begins by using pre-established criteria to select task blocks that require training. The second component in the model generates the training plan, consisting of the following: task blocks to be trained, type of training each will receive, i.e., school or on the job training (OJT), and recommended methods and media for training each task block. The third model component uses the training plan to construct the training program which indicates a schedule for training and the resulting resource requirements. The fourth component required for successful development of a training program is the training analyst. This "man in the loop" feature provides the feedback that enables the process to become self-correcting. The user is able to examine the intermediate outputs of the training model and react to unanticipated variations or repeated irregularities in the procedure.

Operation of the model is based upon the establishment of a data bank containing the list of tasks to be performed. Their level of specificity is a user-defined variable allowing for flexibility of task definition. Each task should be assigned a SCALAR value for each of five task characteristics denoting frequency, criticality, learning difficulty, and psychomotor and cognitive levels. The requirement for this fairly detailed and descriptive data for tasks performed on the system is a constraint on the timing of model usage within an acquisition program.

TRAMOD was designed with interactive program controls in order to give the user the greatest amount of control over its execution. In addition to data inputs, its operation calls for several interactive inputs. TRAMOD prints a request for them as they are needed, and reads input from the terminal in a free format. This prevents the possibility of an aborted computer run due to faulty data and appreciably lessens the amount of preparatory work required of the user. It also helps the user to develop a more complete understanding of the effects of individual data items on training model results.

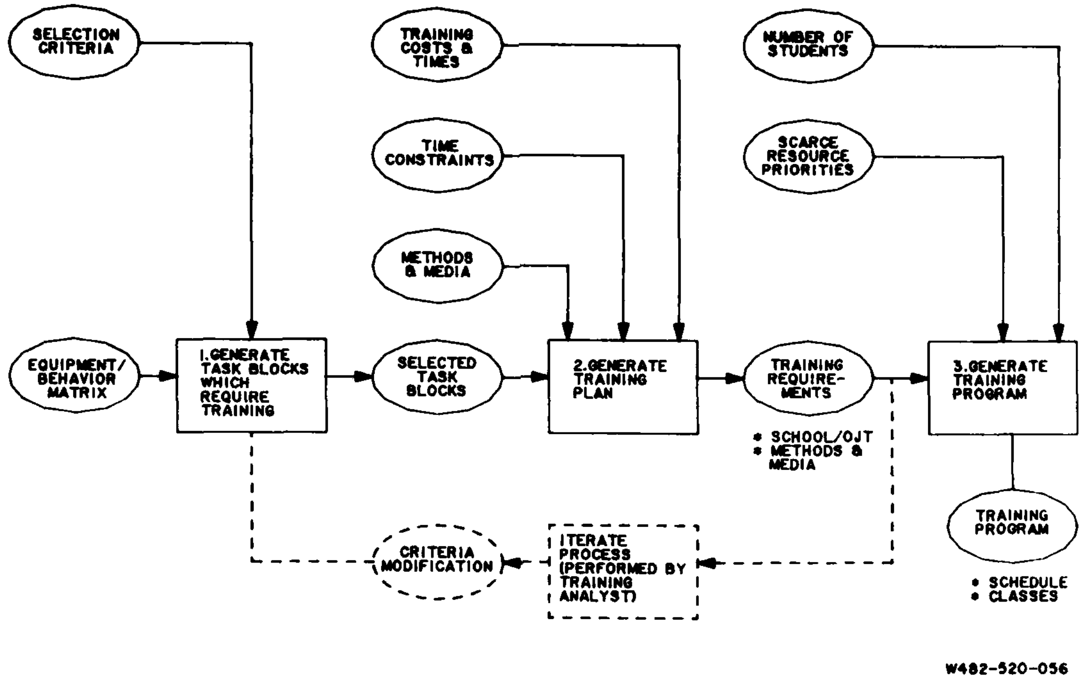

Figure I-10. Elements of Training Requirements Analysis Model

The interactive nature of TRAMOD allows for flexibility in its operation by permitting a variety of options to meet the needs of different training policies and designs. Whenever the program reaches a point where a decision is required in order to continue execution, a message to the user is printed. The program identifies the possible options and waits for the user's input, such as the screening algorithm choice required to establish the users's task selection criteria. There are also occasions where the user is offered the option of changing default values for data, such as methods and media mappings.

Iterative use of TRAMOD lets the user direct the program to repeat analyses, both within and among the major components of the model. This control gives the user the added capability of identifying the sensitivities of the various options and parameter values. Through examining the relative effects of input data changes, the user can identify those elements of design and policy which could develop into problems in the planning of training. This feature makes the model an excellent research tool for the training analyst interested in identifying the potential training consequences of design options for a new weapon system.

3.7 PERSONNEL AVAILABILITY MODEL (PAM)

The Personnel Availability Model (PAM) is a predictive model that provides estimates of the numbers of personnel in specific Air Force Specialty Codes (AFSCs) at user-specified future dates. At present, PAM is limited to projections involving 13 selected maintenance AFSCs, listed in figure I-11. These AFSCs are defined internally in the program and cannot be altered by the user.

PAM calculates career transition activity within the Air Force by a series of transition processes, each depicting a category of airmen defined by AFSC, years of service and paygrade. Probabilities of transition are based on actual transition activity data contained in the Uniform Airman Record (UAR).

The use of PAM results in a forecasting of personnel available in an AFSC of interest. This information may be useful in the performance of the following procedures:

a. Integrated Task Analysis Procedure.

b. Logistic Resources Assessment Procedure.

c. Life Cycle Cost Assessment Procedure.

d. Design Option Decision Tree Procedure.

Basically, PAM operates on UAR data to project future career transition activity on the basis of occurrences in the past. The results are processed to yield "snapshot" descriptions of the total force composition at user-selected intervals. The PAM data bank presently contains a selection of data elements from the 1975 and 1976 UAR files for approximately 95,000 airmen assigned to the 13 AFSCs.

Career transition activity within the Air Force is calculated by a series of Markov processes, each depicting a population of airmen with states defined by years of service (YOS) and paygrade. Transition probabilities are calculated on the basis of actual transition activity data contained in the UAR. Populations may be defined on particular airman attributes such as AFSC designation, or analytically established by applying a discrete dependent variable regression analysis technique.

The model examines the change in state population over a one-year period and calculates the transition probabilities of upgrade, increment (in YOS without change in paygrade), loss from service, and transfer which are stored in a state and probability data base. With this data base, future state populations can be determined by considering the transition dynamics. Transition into a state occurs in one of three ways:

AFSC	SPECIALTY DESCRIPTION
325X0	Automatic Flight Control Systems
325X1	Instrument Systems
328X0	Avionic Communications
328X1	Avionic Navigation Systems
328X4	Inertial and Radar Navigation Systems
423X0	Aircraft Electrical Systems
423X1	Environmental Systems
423X3	Fuel Systems
423X4	Pneudraulic System
426X2	Jet Engines
431X1C	Aircraft Maintenance (Jet, over 2 engines)
431X1E	Aircraft Maintenance (Jet, 1 and 2 engines)
531X3	Airframe Repair

Figure. I-11. Air Force Specialty Codes Used in PAM

a. A transfer from some other AFSC or a new accession into the system.

b. An increase in paygrade with an incremental increase in YOS.

c. An incremental increase in YOS without a change in paygrade.

The PAM operation assumes that state transfer probabilities are constant for each state transfer within a personnel availability projection. The user is allowed to make projections based solely on historical data or to make the desired projections on historical data modified to reflect known or expected changes in the Air Force personnel policy.

PAMs utility is limited in several ways:

a. Fixed embedded personnel data for the years 1975-1976.

b. A single transition period projection.

c. Low confidence in extended years projection.

d. Limited embedded AFSC data subject to obsolescence.

e. Unpredictable external influencing factors.

f. Skill identification uncertainties.

g. Variable experience indicators.

The analyst using PAM can, however, use the services of an experienced personnel specialist to examine outputs and to input current judgments that could make the PAMs output more useful relative to the acquisition's current year.

3.8 LOGISTICS COMPOSITE MODEL (LCOM)

The Logistics Composite Model (LCOM) is one of two models which have been well-established in the modeling community and incorporated into ASSET. LCOM is a dynamic simulation program, which is used to assess maintenance manpower and support equipment requirements. LCOM is a Monte Carlo model and thus is sensitive to the dynamics of the operational scenario. The output, therefore, may be used to identify peak and minimum requirement periods. The simulation may then be used to evaluate trade-offs such as revised operational scheduling or increased manpower. LCOM is based directly on the informaton from a maintenance action network and operations schedule data. The basic output of the simulation is the performance summary report which is used to assess maintenance manpower and support equipment requirements. There are also several auxiliary reports that may be obtained as required.

The use of LCOM may be beneficial in the following procedures:

a. Maintenance Action Network Procedure.

b. Integrated Task Analysis Procedure.

c. Logistic Resources Assessment Procedure.

d. Design Option Decision Tree Procedure.

LCOM is a simulation model used to represent an operational scenario. The data required by this representation may impede the use of this model in the conceptual phase of an acquisition. When the necessary data is available, LCOM is a very useful tool.

3.9 EXPECTED VALUE (EXPVAL) MODEL

The Expected Value Model (EXPVAL) is the second of two models which have been established in the modeling community and incorporated into ASSET. EXPVAL is an average value model, as opposed to the LCOM simulation model, used to assess logistic resources such as maintenance manpower and support equipment requirements. EXPVAL is usually exercised in conjunction with LCOM. Input consists of a list of tasks for each AFSC and items of support equipment. The input data can be extracted directly from LCOM extended form 11 data, the maintenance activity network data file. The output yields the "expected" total maintenance time for each AFSC and use time for each item of support equipment per task.

The assessment of task requirements and logistic resources provided by EXPVAL is useful for the following procedures:

a. Maintenance Action Network Procedure.

b. Integrated Task Analysis.

c. Procedure Logistic Resources Assessment Procedure.

d. Design Option Decision Tree Procedure.

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CHAPTER 4. INTEGRATION WITH ACQUISITION

4.1 GENERAL

Policy for Acquisition Programs is established in Department of Defense Directive (DoDD) 5000.1 and Air Force Regulation (AFR) 800-2 for Major Systems Acquisition. Less-than-major-system acquisition programs follow the policy for major systems. Policy for Integrated Logistics Support (ILS) for major systems acquisition is established in DoDD 5000.39 and AFR 800-8. These require that ILS planning be implemented concurrently with acquisition programs. MIL-STD-1388, Logistics Support Analysis (LSA), is applied to Acquisition Programs as the single analytical process for the ILS Acquisition. Systems Acquisition, ILS Planning, and LSA are all initiated at Defense System Acquisition Review Council (DSARC) Milestone 0 (concept exploration phase) of an acquisition.

The ASSET Technology package is a useful set of procedures and models which can be applied early in an Acquisition Program, i.e., at Milestone 0. ASSET is applicable to and compatible with the Systems Acquisition process and its accompanying ILS and LSA processes, and is particularly useful during the DSARC 0, concept exploration phase. This section presents the integration of the ASSET package with the acquisition process.

4.2 CONCEPT EXPLORATION PHASE

The Concept Exploration Phase (often called Conceptual Phase or Program Initiation Phase) is the period of time between DSARC 0, the milestone at which the "decision to acquire" is made and DSARC I, the milestone at which the "decision to proceed" into the validation and demonstration phase is made. The conceptual phase is devoted to what its title implies, the exploration of competing concepts which satisfy the need.

This ASSET Guide concentrates on the application and use of ASSET in the conceptual phase of an Acquisition Program, fully integrated into the Acquisition, ILS, and LSA processes.

4.3 CONCEPTUAL PHASE DEFINITION

In order to readily orient the user of this guide to ASSET's integration into an acquisition program and to maintain compatibility with the acquisition, ILS, and LSA processes, the conceptual phase is described as consisting of five basic events which typically and logically occur between the DSARC 0 and DSARC I decision milestones, i.e., during the conceptual phase. The five basic events are:

a. Requirements Determination.

b. Conceptual Systems Design.

c. Conceptual Support Design.

d. Evaluation of Concepts.

e. Concept Selection.

The five basic events, generic in nature, are also descriptive of follow-on acquisition phases, with only definitive details being different, as an acquisition program moves through its phases toward deployment, operations, and support.

The five basic events are time-based measurements, within which a number of tasks and subtasks are described, the number dependent upon the complexity of the Acquisition Program.

In order to acquaint the user of this guide with the task of ASSET integration into an acquisition program, certain assumptions are made concerning the conceptual phase. The five basic events are considered to be end-to-end, and considered to contain a given number of first-level tasks.

The user will understand that several of the end-to-end events (and tasks) could actually be performed in parallel, as the user "tailors" the typical events and tasks to the acquisition program of concern, with its unique characteristics. In addition, the user will extend each first-level task down to sub-tasks and steps, etc., to the extent necesary to suitably define the depth of work of the acquisition events.

With cognizance of the foregoing ground rules, this guide delineates the five events and first-level tasks in paragraph 4.4, below. The events and associated tasks are given convenient numeric designations which can be extended as other sub-tasks (and steps) are added. The events and tasks defined are applicable to both Government and contractor agencies.

NOTE

It must be assumed that the Government has accomplished certain work associated with the DSARC 0 decision and initiation of the conceptual phase of the acquisition, such as:

a. Mission Element Need Statement (MENS).

b. Statement of Operational Need (SON).

c. Budgeting and Funding Process.

d. Issuance of Program Management Directive (PMD).

e. Appointment of Acquisition Systems Program Officer (SPO) and Deputy Program Manager for Logistics (DPML).

f. Issuance of Program Management Plan (PMP).

g. Issuance of a Request for Proposal (RFP) with Statement of Work (SOW), Contractor Data Requirements List (CDRL) and accompanying documentation.

4.4 CONCEPTUAL PHASE EVENTS AND TASKS

Each of the five events in the following series is accompanied by a series of tasks numbered compatibly to the event number. The series represents the work to be accomplished in a "typical" Acquisition Conceptual Phase, expressed generically in order to be applicable to any type of Acquisition Program. The series of events/tasks, therefore, becomes a "roadmap" that can be followed relative to progress through the conceptual phase. This series subsequently becomes the reference for integration of ASSET techniques into the appropriate events/tasks of a program, as addressed in Paragraphs 4.5 and 4.6 below.

EVENT 1.0	REQUIREMENTS DETERMINATION
Task 1.1	Data Identification and Assembly
Task 1.2	Data Study and Assimilation
Task 1.3	Data Management and Distribution
Task 1.4	Formulation of Mission Requirements
Task 1.5	Formulation of System Design Requirements
Task 1.6	Formulation of Support Design Requirements
Task 1.7	Identification of System/Support Constraints
Task 1.8	Documentation of Requirements
Task 1.9	Documentation of Program Performance, Schedule and Cost Requirements
EVENT 2.0	CONCEPTUAL SYSTEM DESIGN
Task 2.1	System Capability Definition
Task 2.2	System Interface Definition
Task 2.3	System Design Definition
Task 2.4	System R, M, S, HI and Supportability Definition
Task 2.5	System Configuration Definition
Task 2.6	System Operational Scenario Preparation

<u>EVENT 2.0</u>	<u>CONCEPTUAL SYSTEM DESIGN - Continued</u>
Task 2.7	Alternative System(s) Definition
Task 2.8	Documentation of System Definition(s)
Task 2.9	Documentation of System Performance, Schedule and Cost
<u>EVENT 3.0</u>	<u>CONCEPTUAL SUPPORT DESIGN</u>
Task 3.1	Evaluation of Mission
Task 3.2	Evaluation of System Operational Scenario
Task 3.3	Analysis of System Support Tasks
Task 3.4	Formulation of Maintenance Concept
Task 3.5	Formulation of Operational Support Scenario
Task 3.6	Definition of Support Factors
Task 3.7	Definition of Support Resources
Task 3.8	Definition of Support Alternative(s)
Task 3.9	Documentation of Support Definition(s)
Task 3.10	Documentation of Support Performance, Schedule and Cost
<u>EVENT 4.0</u>	<u>EVALUATION OF CONCEPTS</u>
Task 4.1	Quantify Baseline and Alternative Conceptual System Designs
Task 4.2	Tradeoff System vs. System Alternatives
Task 4.3	Tradeoff System Element vs. System Element Alternatives
Task 4.4	Quantify Baseline and Alternative Conceptual Support Designs
Task 4.5	Tradeoff Support vs. Support Alternatives
Task 4.6	Tradeoff Support Element vs. Support Element Alternatives
Task 4.7	Tradeoff System vs. Support Alternatives

EVENT 4.0	EVALUATION OF CONCEPTS - Continued
Task 4.8	Evaluate Optimal System/Support Combination
Task 4.9	Document Mission/Operation/System/Support Scenario(s)
Task 4.10	Document Risks of System/Support Performance, Schedule and Cost
Task 4.11	Document Optimal System/Support Proposal
EVENT 5.0	CONCEPT SELECTION
Task 5.1	Review Mission/Operation/System/Support Requirements
Task 5.2	Review Acquisition Program Requirements
Task 5.3	Review Source Selection Evaluation Requirements
Task 5.4	Review Each System/Support Proposal
Task 5.5	Tradeoff Individual Proposals
Task 5.6	Apply Source Selection Evaluation Criteria
Task 5.7	Select Best System/Support Proposal(s)
Task 5.8	Document Source Selection Recommendations

NOTE

It must be assumed that the Government will accomplish certain work associated with the conclusion of the Conceptual Phase of the Acquisition and the DSARC I Decision, such as:

a. Decision Coordination Paper (DCP).

b. DSARC Process.

c. Review of MENS and SON.

d. Source Selection Process.

e. Budgeting and Funding Process.

f. Preparation for DSARC I Validation and Demonstration Phase.

4.5 CONCEPTUAL PHASE ASSET INTEGRATION

Using the foregoing generic definition of the events and tasks within the conceptual phase as a "roadmap", the user may insert, or apply, the ASSET procedures/models as required to secure the greatest benefits to the user's acquisition program. Also, using the listed events and tasks as the basis of a typical schedule, this guide will integrate the ASSET techniques with given events and tasks in a static manner, representative of a typical acquisition.

The user will recognize that the integration of ASSET techniques is flexible and adaptable to both time-based events and workdepth tasks and that the user has considerable latitude in application. An understanding of ASSET capablities and benefits and of acquisition methodology is a requirement for successful integration.

Paragraph 4.6 addresses identification of specific events/tasks with which one or more ASSET techniques may be integrated. (The actual application procedure for ASSET techniques is delineated in Section V of this guide.) Figure I-12 is a matrix displaying integration/application relationships of events/tasks and ASSET procedures.

4.6 ASSET INTEGRATION

This paragraph addresses the events and tasks, delineated in Paragraph 4.4, above, and selects certain representative events and tasks with which the several ASSET procedures are integrated. The matrix in figure I-12 is a simplified illustration of the integration. The user will realize that tasks not addressed are significant to the selected tasks, as they either provide inputs to or use outputs from the tasks selected for ASSET integration. (The ASSET models are not addressed here, as they are implemented by the ASSET procedures.)

4.6.1 Event 1, Tasks 1.1 and 1.2

The Program Definition Analysis Procedure is applied to the tasks of data gathering, study and reduction, relative to all requirements for the acquisition and its program, in order to fully define the acquisition objectives.

4.6.2 Event 1, Tasks 1.3 through 1.9

The Consolidated Data Base Procedure is applied to the task 1.3 of establishing a data bank for all developed requirements and for managing it for use of all future data generated during the program.

The Program Definition Analysis Procedure is applied for continuing study and reduction of all requirements data.

4.6.3 Event 2, Tasks 2.4 and 2.8; Event 3, Tasks 3.3 and 3.4

The Integrated Task Analysis Procedure is applied to the tasks of analysis of system reliability and maintainability and associated data to provide a basis for maintenance support studies.

ACQUISTION EVENT/TASK — ASSET PROCEDURE	1.1 1.2	1.3 THRU 1.9	2.4 2.8 3.3 3.4	3.6 THRU 3.9	4.4 THRU 4.7	4.8 THRU 4.11	2.8 2.9 3.9 3.10 4.9 4.11	5.5 5.7
PROGRAM DEFINITION ANALYSIS PROCEDURE	X	X						
CONSOLIDATED DATA BASE PROCEDURE		X	X	X	X	X	X	
INTEGRATED TASK ANALYSIS PROCEDURE			X					
MAINTENANCE ACTION NETWORK PROCEDURE			X					
LOGISTIC RESOURCES ASSESSMENT PROCEDURE				X	X	X		X
COMPARABILITY ANALYSIS PROCEDURE					X	X		
LIFE CYCLE COST ASSESSMENT PROCEDURE					X	X		X
DESIGN OPTION DECISION TREE PROCEDURE						X		X

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Figure I-12. ASSET Procedure Integration/Application Matrix

The Maintenance Action Network Procedure is applied to the tasks of formulating a maintenance concept in support of the system support tasks and identifying maintenance requirements.

The Consolidated Data Base Procedure is applied to enter into the data base the results of the associated tasks.

4.6.4 Event 3, Tasks 3.6 through 3.9

The Logistics Resource Assessment Procedure is applied to the definition of all support factors leading to definition of specific resources and alternatives in support of the system and its possible alternatives.

The Consolidated Data Base Procedure is applied to assure preservation of all pertinent data derived from the prior tasks.

4.6.5 Event 4, Tasks 4.4 through 4.7

The Logistics Resource Assessment Procedure is applied to the refined definition of all alternative resources for support of the system and alternatives.

The Comparability Analysis Procedure is applied to fully defined support resources to quantify all related elements in terms of Life Cycle Costs through comparison with an equivalent, existing system.

The Life Cycle Cost Assessment Procedure is applied to fully defined system and support resources and alternatives in terms of the Life Cycle Cost.

The Consolidated Data Base Procedure is applied to record all significant data in a continuing and updating process.

4.6.6 Event 4, Tasks 4.8 though 4.11

The Logistic Resource Assessment Procedure is applied to iterated assessments of finalized Logistics Support resources.

The Comparability Analysis Procedure is applied to finalized updating and refined Life Cycle Costing factors.

The Life Cycle Cost Assessment Procedure is applied to system and support resources evaluation for finalization of Life Cycle Costing analysis criteria.

The Design Option Decision Tree Procedure is applied to aid in the visibility on alternatives and selection of the optimal logistic resources for support of the established system.

The Consolidated Data Base Procedure is applied commensurately with optimal selection of resources to fully identify and retain all pertinent data.

4.6.7 Event 2, Tasks 2.8 and 2.9; Event 3, Tasks 3.9 and 3.10; Event 4, Tasks 4.9 and 4.11

The Consolidated Data Base Procedure is applied for a complete audit, evaluation, screening and finalization of all accumulated data about the established system and final logistics resources selected.

4.6.8 Event 5, Tasks 5.5 and 5.7

The Logistics Resources Assessment Procedure, Life Cycle Cost Assessment Procedure and Design Option Decision Tree Procedure are collectively applied as aids in the decision process relative to selection of the optimal system/resources combination among several competing system/resources proposals.

4.7 ASSET PACKAGE UTILIZATION

The foregoing integration of the ASSET procedures (and combinations of procedures) have been applied to the previously described events and tasks inherent in a "typical" conceptual phase of an acquisition. The integration is not rigidly fixed, but used relatively to display the usefulness of the ASSET package to an acquisition. The user has a considerable number of integration and application options for meeting the actual acquisition program's unique schedules and task complexities. The user can extend or compress schedules, increase or decrease task depth and place tasks into either sequential or parallel orders for accomplishment. The purpose of the integration guide is to aid and assist the user in the realization of the benefits of integrating the ASSET package into the acquisition independently, in conjunction with ILS planning in accordance with DoDD 5000.39 and AFR 800-8, and/or in conjunction with MIL-STD-1388 LSA.

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CHAPTER 5. APPLICATION OF THE ASSET METHODOLOGY

The ASSET methodology is applied to a weapon system during its acquisition process in order to impact the design and acquisition decision with supportability considerations. The ASSET analysis is applied or accomplished through a series of analysis procedures, each of which details the possible use of one or more of the individual ASSET models.

This chapter presents the analysis procedures in an order in which they would be applied in a weapon system acquisition program. Each procedure is presented in sufficient detailed tasks and steps as to provide the user with a plan to apply the procedure and thus to apply the ASSET methodology.

Not all procedures and tasks included in the procedures are mandatory in an application program, although the relative ordering of the procedures and tasks must be maintained. The application may be tailored to an individual program through decisions to include or omit specific tasks. This tailoring is initially accomplished as part of the first procedure, the Program Definition Analysis Procedure. Decisions as to which models and techniques to use in the accomplishment of each procedure may also be made at the same time or may be deferred to the time of the particular procedure application.

5.1 PROGRAM DEFINITION ANALYSIS PROCEDURE

This is the critical first step in the application of ASSET through which the logistical analysis program, effort and goals are established. Based on the application program defined, the ASSET procedures are reviewed and a decision made as to the application and timing of each.

There is a series of questions which must be answered during the program definition analysis. The answers serve to define the total scope and detail of the ASSET application. This is not to say the decisions made now are irreversible or cannot be altered, for the scope and/or level of detail of each procedure can be altered during the performance of the particular procedure. An initial decision on the applicable computer models to be used in the weapon system analysis can also be made during this analysis. This too may be changed in response to specific requirements or system data availability.

A sample of the items which must be addressed during the PDA is presented below:

a. Weapon System Identification.

b. Equipment Hierarchy.

c. Comparable System or Subsystem Identification.

d. Logistic Resources Requirements Needed.

e. Life Cycle Cost Assessment Required.

f. Depth of Task Analysis Required.

5.2 CONSOLIDATED DATA BASE (CDB) PROCEDURE

Consolidated data base (CDB) is the term used to describe the central depository for all data required for the application of ASSET. The CDB includes the general categories of program requirements, logistics support assumptions and constraints, and manual logistics plans as well as data files in the computer sense which are required for the application and execution of the models associated with ASSET. The CDB is structured in such a manner as to be compatible with the logistics support analysis record (LSAR) for later transition to this medium when or if required.

The generic events or tasks to be accomplished in the initial establishment of the CDB are outlined below:

a. Data Management and Distribution Definition.

b. Data Categories Identification and Assembly.

c. Data Study and Assimilation.

d. Data Documentation.

The CDB is established initially in an ASSET application in line with the program definition determined through the program definition analysis. The control and administration aspects of the CDB are also established to centralize authority to control the data and limit the ability to alter or update data thus ensuring validated data. Control is established to permit data relating to the multiple alternatives for system design and support concepts and provide a means for separating the data for each alternative to avoid confusion.

The detailed structure of the CDB was initially described in a functional specification contained in AFHRL-TR-78-6 (III). The major categories, as defined by this specification were the six listed below:

a. Maintenance Data.

b. Equipment Data.

c. Operations Data.

d. Cost Data.

e. Alternate Data.

f. Decision Data.

These categories have now been modified and new categories included to expand the CDB and facilitate interface with or transition to a logistics support analysis record (LSAR) data bank.

The categories of data to be included for documentation in the CDB are listed below and shown in figure I-13.

a. Weapon System Identification and Requirements.

b. Program Directives and Scenario.

c. Maintenance Concept.

d. Reliability Data.

e. Maintainability Data.

f. Tasks, Personnel and Training Data.

g. Support Equipment.

h. Facilities.

i. Software.

j. Technical Manuals.

k. Costing Data.

Figure I-14 presents a matrix showing the correlation between the six categories in the initial functional specification and the eleven present categories. The new categories added are:

a. Program Directives and Scenarios.

b. Maintenance Concept.

c. Support Equipment.

d. Facilities.

e. Software.

f. Technical Manuals.

The following paragraphs present a description of each of the CDB categories.

5.2.1 Weapon System Identification and Requirements

The primary results of the Program Definition Analysis are recorded in this category. Included are the weapon system requirements and the associated support system requirements. The weapon system equipment hierarchy is also recorded here as well as the identification

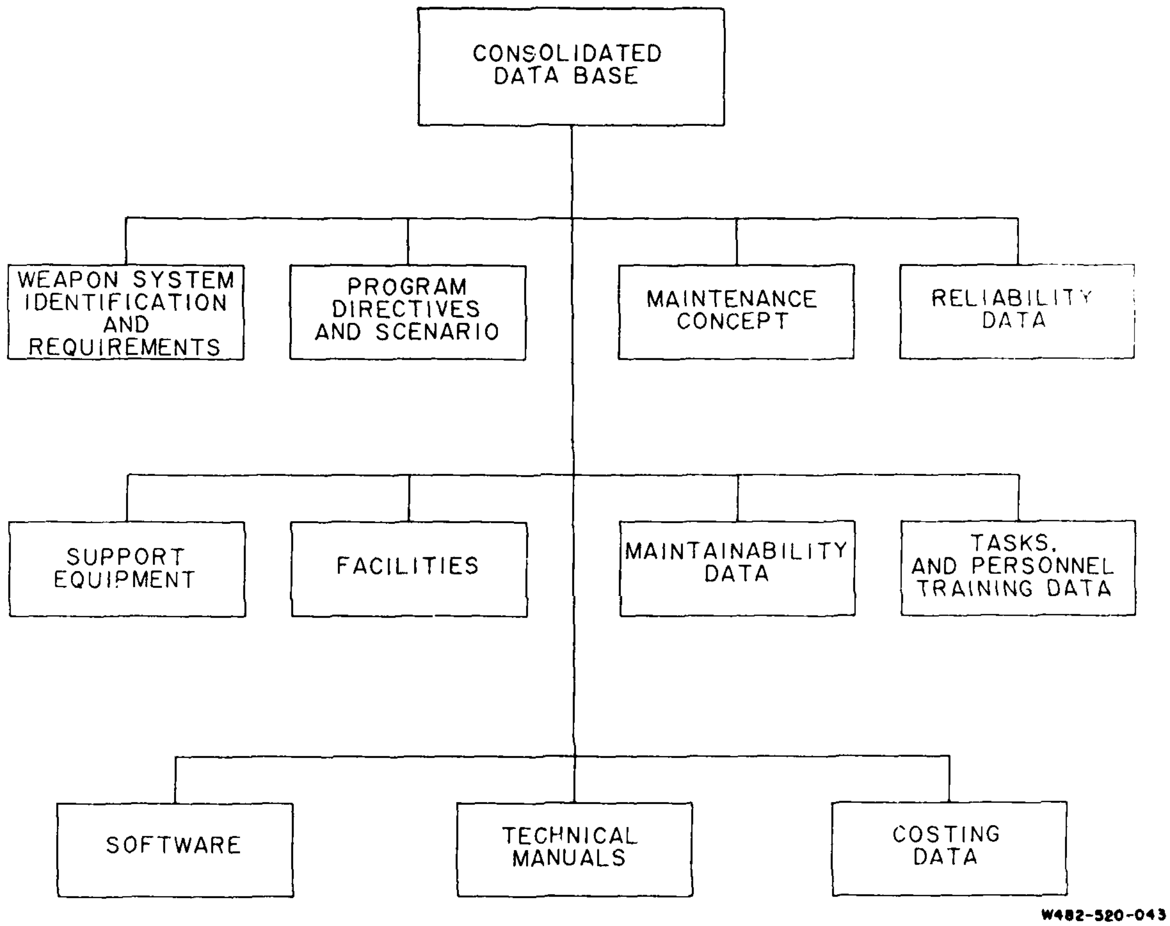

Figure I-13. Consolidated Data Base

	MAINT. DATA	EQUIP. DATA	OPER. DATA	COST DATA	ALT. DATA	DEC. DATA
WEAPON SYSTEM IDEN. REQ.		X			X	
PROG. DIRECT. & SCENARIO						
MAINTENANCE CONCEPT						X
RELIABILITY DATA		X				
MAINTAINABILITY DATA		X			X	
TASKS, PERSONNEL & TRAINING DATA	X		X			X
SUPPORT EQUIP.						
FACILITIES						
SOFTWARE						
TECHNICAL MANUALS						
COSTING DATA				X		X

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Figure I-14. CDB Correlation with Functional Specification

of alternate systems or configurations of interest for analysis. Included with the alternative identification will be any DODT(s) constructed for the weapon system.

5.2.2 Program Directives and Scenario

Included in this category are the Mission Element Need Statement (MENS) and Statement of Operational Need (SON) for the weapon system. All program directives generated are also recorded in this category. The definition and description of the operation scenario, contained in the MENS and SON, must be specifically documented to allow reference for impact on the support system.

5.2.3 Maintenance Concept

The decisions evolving into the system maintenance concept are recorded in this category of the CDB. Items include the diagrams of maintenance flow in support of the weapon system and the maintenance action networks developed to depict the maintenance concept and weapon system availability requirements.

The life cycle cost estimate for the maintenance concept and possible alternatives is also recorded with the appropriate concept.

The weapon system integrated logistics support plan (ILSP), integrated support plan (ISP), and maintenance plan (MP) are included when prepared.

5.2.4 Reliability Data

All data relating to the reliability of the weapon system and associated support system, either in total or for subcomponents thereof, is recorded in the CDB. Specific elements include:

a. Reliability Requirements.

b. Failure Mode Identification.

c. Failure Effects Analysis.

d. Failure Rates.

e. Mean Time Between Failures (MTBF).

f. Mean Flying Hours Between Maintenance Actions (MFHBMA).

5.2.5 Maintainability Data

All data relating to the maintainability of the weapon system and associated support system, either in total or for subcomponents thereof, is recorded in this category of the CDB. Specific elements include:

a. Maintainability Requirements.

(1) Test Requirements.

(2) Built-in-Test (BIT) Requirements.

b. Mean Time to Repair (MTTR).

c. Availability Requirements.

5.2.6 Tasks, Personnel and Training Data

This category of the CDB is used to record the information gathered and generated through the integrated task analysis procedure. Data includes that which identifies the tasks relating to the weapon system, personnel requirements and availability, and skills and training requirements for these personnel.

Within this category, the weapon system operation data and maintenance data are separated, thus creating two major subcategories. Specific elements included in each subcategory are:

a. Task Identification.

b. Manpower Requirements.

c. Personnel Requirements.

(1) Skill Level.

(2) Air Force Specialty Code.

d. Personnel Availability.

e. Tool Requirements.

f. Training Requirements.

5.2.7 Support Equipment

Requirements for items of support equipment to support the weapon systems are recorded in this category of the CDB. Information defining and describing the support equipment such as tasks which require it, measurement ranges and tolerances, and power requirements, are documented to the depth and level of detail permissible with the availability of this data.

5.2.8 Facilities

Facilities required for the operation and support of the weapon system are identified through the integrated task analysis procedure and documented in this category of the CDB. As information is gathered and requirements firmed, the recorded facility needs are annotated as to whether existing facilities are sufficient for use or new facilities are required.

5.2.9 Software

This category of the CDB is used to document software requirements of the weapon system when required.

5.2.10 Technical Manuals

This category is used to document requirements for technical manuals in support of the weapon system. Initially, a list of the requisite manuals is recorded. As more information is available, estimates of content and number of pages are recorded. Copies of technical manual drafts and final products are included when prepared.

5.2.11 Costing Data

Costing data required to conduct a life cycle cost assessment and analysis is recorded in this category. Also included is the identification of the LCC model used and results of the analysis.

5.3 INTEGRATED TASK ANALYSIS PROCEDURE

The integrated task analysis in ASSET is the systematic study of the requirements for tasks which must be performed to operate and maintain a weapon system. The goals of this analysis are:

a. Identification of task relating to the weapon system and equipment.

b. Identification of logistic resources required by the tasks and allocation of these for task performance.

c. Task performance descriptions to assist in training and technical publication planning.

There are essentially two levels of task analysis: (1) the initial task identification, and (2) the subsequent detailed analysis of the identified tasks. The second level, in turn, encompasses many levels of analysis relating to the scope and level of detail required by the particular acquisition phase and the limits or constraints of the available data to accomplish the task analysis. With respect to this, the integrated task analysis is an iterative task with further depth and detail provided with the timing of data availability.

The principal activities or tasks constituting the ITA are as outlined below:

a. Review System Operation and Support Concepts.

b. Define Operation and Maintenance Tasks.

c. Develop Preliminary Task Identification Matrix.

d. Define and Assign Personnel and Skill Requirements.

e. Define and Allocate Support Equipment.

f. Determine Tasks Recording Formats.

g. Define or Review Level of Detail Guide.

h. Perform Task Performance Analysis.

i. Record Tool and Test Equipment Requirements.

5.4 MAINTENANCE ACTION NETWORK PROCEDURE

The maintenance action network (MAN) procedure acts as an interface linkage between the integrated task analysis procedure and the logistic resources assessment procedure. Through the MAN procedure, a maintenance action network is generated which depicts the maintenance concept for the weapon system. From this, a general maintenance flow diagram can be constructed. As data is made available through the ASSET procedures, the MAN is annotated with probabilities of events or tasks, personnel and skill requirements, support equipment requirements and mean task performance time.

The form and complexity of the maintenance action network can vary depending on the analysis technique chosen. Within ASSET, the analysis techniques available are manual, the use of the RM model and RMCM or the use of LCOM and/or EXPVAL. Thus, this decision must be made before the MAN is expanded.

The tasks performed during the MAN procedure are outlined below:

a. Construct Basic MAN.

b. Decide on Analysis Techniques.

(1) Manual.

(2) RM/RMCM.

(3) LCOM/EXPVAL.

c. Expand MAN as Required.

d. Determine Task Probabilities.

e. Record Personnel and Skill Requirements.

f. Record Mean Task Time.

g. Allocate Support Equipment.

The data used to annotate the MAN is generally obtained during the integrated task analysis procedure. The recorded data is then utilized in the logistic resources assessment procedure and life cycle cost

assessment procedure to identify and analyze the weapon system's support requirements.

5.5 LOGISTIC RESOURCES ASSESSMENT PROCEDURE

Through the accomplishment of this procedure, the first analytical indication of the logistic resources required by the system is determined. The performance of this assessment begins with the initial task analysis. This is expanded into a more detailed analysis with a review of the support requirements and resources needed to fulfill or complete the identified tasks. These resources include, but are not limited to, manpower, personnel and skills, support equipment, spares, facilities, technical manuals and documentation, and training requirements.

This task generally requires the use of the associated analytical computer models to specify and track resource requirements. The decision as to which models to use must be made early for this decision will impact further procedural tasks.

A general listing of the tasks included in the logistic resources assessment procedure is outlined below:

a. Review Integrated Task Analysis.

b. Review Maintenance Action Network.

c. Decision on Technique.

  (1) Manual.

  (2) Average Value.

  (3) Dynamic Simulation.

d. Gather Data.

e. Allocate Support Equipment.

f. Execute Assessment.

g. Analysis.

h. TAM Utilization.

i. PAGES Utilization.

5.6 COMPARABILITY ANALYSIS PROCEDURE

Within the ASSET application, the comparability analysis is conducted to extract information on the weapon system support. A comparability analysis refers to the overall process used to develop data on newly proposed or designed weapon systems by (1) selecting operational equipment similar to that of the proposed weapon system and

(2) adjusting the resource data associated with operational equipment to reflect the unique characteristics of the proposed equipment. The comparability analysis includes a requirement for finding operational equipment that is similar to the proposed equipment. It also includes the development of maintenance demand rates for the proposed equipment which, in turn, can be used to determine resource requirements (such as manpower, support equipment, and spares for the weapon system).

The comparability analysis is initiated using the outline of the proposed or newly developed weapon system and the comparable system identified during the program definition analysis. Data elements required to complete or refine either the logistic resources assessment or the life cycle cost assessment are identified and similar elements relating to the comparable system are modified for usage.

5.7 LIFE CYCLE COST ASSESSMENT PROCEDURE

The assessment of the life cycle cost (LCC) for a weapon system is one of the most visible products of the ASSET application. As such, the analyst must be cautious to ensure cost data elements are accurate reflections and forecasts of those which will be presented by the system under analysis. Placing the life cycle cost assessment after the logistic resources assessment enables the initial task analysis and the logistic resources assessment to be conducted prior to a cost analysis.

The LCC assessment procedure in ASSET centers on the use of the RMCM. The analyst must be familiar with the assumptions and capabilities of this model before initiating the LCC assessment. The required data is then collected and the assessment analysis is begun.

The identification and collection of data for the LCC assessment is a function of the application program requirements. The identification of applicable and appropriate data should be accomplished before much effort is spent in what may be non-essential activities. THE RMCM addresses the recurring and non-recurring costs (including system disposal costs) of a weapon system. Some of these costs may not be of interest in a particular application program. Examples of these are the costs of system disposal, research and development, fuel, and software development.

5.8 DESIGN OPTION DECISION TREE PROCEDURE

The DODT procedure within ASSET provides a means to inject supportability factors into the existing DODT methodology. A supportability evaluation is given for selected alternatives in the weapon system or subsystem DODT.

The DODT procedure is listed as the final ASSET procedure, not because it is necessarily the last one to be performed but because the procedure interfaces with an existing methodology and relies on the other ASSET procedure to generate data for application. Examples of the supportability considerations which may be acknowledged on the DODT are:

a. Personnel and Skill Requirements.

b. Support Equipment Requirements.

c. Facility Requirements.

d. Availability Estimates.

e. Total Life Cycle Cost.

f. Components of LCC.

g. FOMs Detailed by the RM Model.

The generation of these considerations is performed by the application of the appropriate procedure.

END

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